USDA
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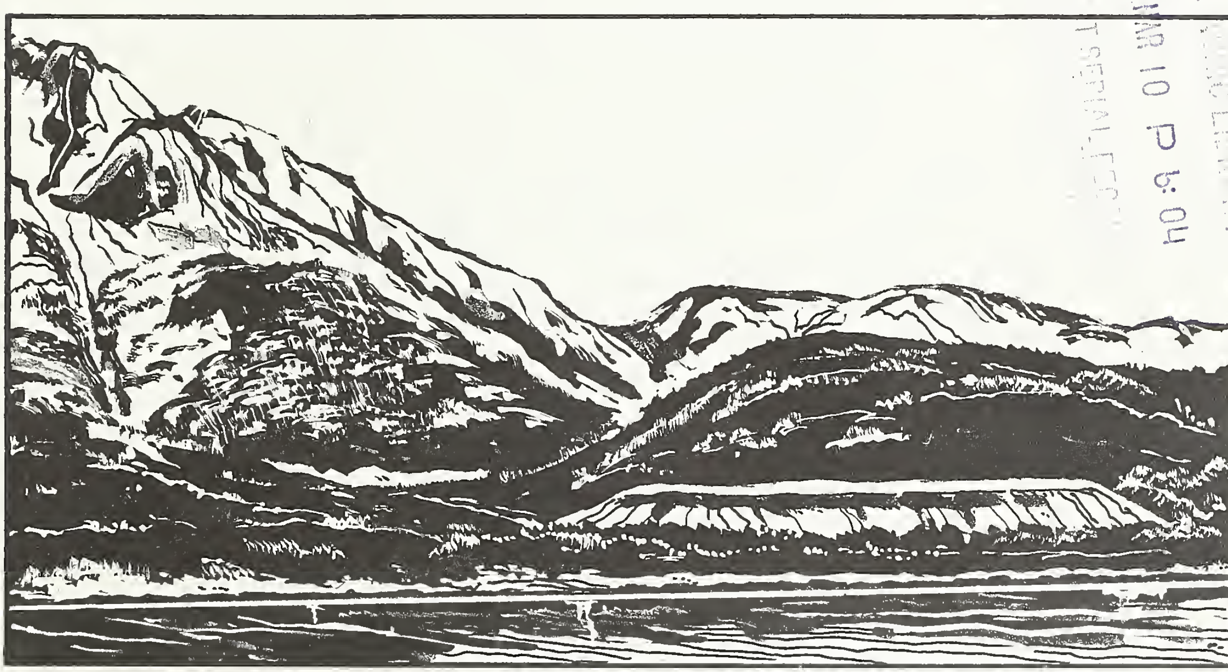
Forest Service

Tongass
National
Forest
R10-MB-343

Kensington Gold Project

DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT



Cooperating
Agencies

EPA

United States Department of Agriculture | Forest Service | Alaska Region
Tongass National Forest
Fax (907) 586-8808 | Juneau Ranger District
8465 Old Dairy Road
Juneau, Alaska 99801
907 586-8800

Date: February 18, 1997

Dear Reviewer

Enclosed for your review and comment is the Kensington Gold Project Draft Supplemental Environmental Impact Statement for Coeur Alaska, Inc.'s proposed gold mine north of Juneau, Alaska.

The Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers are cooperating agencies which have participated in this process. This document was prepared by SAIC, a third party contractor, under the direction of the Forest Service, EPA, and Corps of Engineers.

The DSEIS presents the alternatives that have been developed to resolve the issues identified during scoping, the environment potentially impacted by the development, and the environmental consequences of each alternative.

The preferred alternative, as identified by the Forest Service, EPA, and Corps of Engineers is Alternative D - Modified Dry Tailings Facility.

Comments are due by April 7, 1997, and should be sent to:

Roger Birk
EIS Team Leader
Juneau Ranger District
8465 Old Dairy Road
Juneau, AK 99801

Public Information meetings are scheduled for March 25, 1997, at Centennial Hall in Juneau and for March 26, at the Chilkat Center in Haines. These meetings will combine a question and answer format with a public hearing. In addition, on March 6, from 1 to 5 p.m., the Forest Service and SAIC Interdisciplinary Team members will be available at the Juneau Ranger District office to meet with interested persons individually to answer questions about the analysis in the Draft SEIS.

If you have any questions or would like to schedule an appointment with the IDT for March 6, please contact Roger Birk at 907-586-8800. Thank you.

Sincerely,

Janis S. Burns Buyarski

JANIS S. BURNS BUYARSKI
Deputy District Ranger

Kensington Gold Project Draft Supplemental Environmental Impact Statement

United States Department of Agriculture
Forest Service
Tongass National Forest

February 1997

COVER SHEET

Lead Agency:	USDA Forest Service Tongass National Forest Chatham Area
Responsible Officer:	Gary Morrison Forest Supervisor
Cooperating Agencies:	U.S. Environmental Protection Agency U.S. Army Corps of Engineers
Point of Contact:	Roger Birk Juneau Ranger District 8465 Old Dairy Road Juneau, Alaska 98101 (907) 586-8800
Document Designation:	Draft Supplemental Environmental Impact Statement
Abstract:	This document evaluates the potential environmental consequences associated with proposed modifications to the 1992 Plan of Operations for the Kensington Gold Project. The Kensington Gold Project is a proposed gold mine located 45 miles north of Juneau, Alaska. If the Proposed Action were implemented, it would include use of dry tailings management, offsite processing of flotation concentrate, and use of diesel fuel for power generation. Evaluation factors for the proposed modifications primarily include effects on marine and fresh water resources, air quality, wetlands, transportation, and visual resources. Alternatives addressed include the No Action Alternative, the Proposed Action, and two other alternatives developed based on scoping issues.
Comments Should Be Addressed To:	Roger Birk Juneau Ranger District 8465 Old Dairy Road Juneau, Alaska 98101
Review Comment Deadline:	April 7, 1997

SUMMARY

SUMMARY

Coeur Alaska, Incorporated, submitted a revised proposal to the U.S. Department of Agriculture, Forest Service, Tongass National Forest, Chatham Area, for proposed project changes to the Kensington Gold Project. In July 1992, the Forest Service approved a Plan of Operations for the Kensington Gold Project (1992 Plan of Operations). The 1992 Plan of Operations reflects the Forest Service Record of Decision (ROD) issued on January 29, 1992, for the Final Environmental Impact Statement (FEIS). The 1992 Plan of Operations addresses the preferred alternative selected by the Forest Service—Alternative F, Water Treatment Option 1. Alternative F consists of underground mining; ore processing, including onsite cyanidation; a tailings impoundment; marine discharge of process wastewater; and various support facilities, including use of liquefied petroleum gas (LPG) for power generation.

As cooperating agencies, the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (Corps of Engineers) were responsible for issuing RODs prior to issuing permits. Neither agency issued a ROD or permits. EPA prepared the *Kensington Gold Mine Project, Technical Assistance Report* (TAR) (EPA, 1994) to evaluate potential short- and long-term water quality impacts and potential long-term ecological consequences of the preferred alternative identified in the Forest Service ROD. EPA developed findings and recommendations to assist the Corps of Engineers in determining whether the proposed project would comply with Section 404(b)(1) guidelines of the Clean Water Act.

The Kensington Gold Project was originally a joint venture between Coeur Alaska (a subsidiary of Coeur d'Alene Mines Corporation) and Echo Bay Exploration (a subsidiary of Echo Bay Mines, Ltd.). During summer 1995, Coeur Alaska assumed 100-percent interest in the Kensington Gold Project. On June 24, 1996, Coeur Alaska (the operator) submitted a Revised Plan of Operations (1996 Revised Plan of Operations). The revision includes offsite transportation of flotation concentrate, thereby eliminating onsite cyanidation; dry disposal and backfilling of tailings; fresh water discharges of process wastewater; use of diesel fuel for power generation; and modifications to the facility layout.

The Forest Service has determined that a decision on the 1996 Revised Plan of Operations would be a major Federal action requiring a Supplemental Environmental Impact Statement (SEIS) under the National Environmental Policy Act (NEPA). The Council on Environmental Quality (CEQ) issues NEPA regulations and guidelines. Each Federal agency is responsible for developing its own regulations and guidelines for compliance with NEPA. This Draft SEIS was prepared in accordance with applicable CEQ and Forest Service regulations and guidelines and in cooperation with EPA and the Corps of Engineers. This Draft SEIS only considers the proposed changes to the project. Elements of the Kensington Gold Project that are not proposed for modification from the 1992 Plan of Operations were evaluated in the FEIS and are not addressed in this document.

This summary briefly describes the primary contents of the Draft SEIS as follows:

- Chapter 1, Purpose of and Need for Action—Describes the project revisions as proposed by the operator; discusses the need for the SEIS and other Federal, State, and local permits; and identifies issues raised during the scoping process and addressed by this analysis.
- Chapter 2, Description of Alternatives, Including the Proposed Action—Describes how the alternatives were developed, discusses the revised proposal offered by the operator, and identifies the other alternatives chosen for consideration.
- Chapter 3, Affected Environment—Provides updated and supplemental information collected since the FEIS on the physical and biological environment and socioeconomic conditions that would be affected by the alternatives.
- Chapter 4, Environmental Consequences—Describes the potential environmental consequences of all alternatives.

This summary provides an overview of the SEIS, including important information from Chapters 1 through 4. The SEIS and two accompanying technical resource documents provide detailed information. Beyond the information in the FEIS, additional documentation of the environmental analysis is contained in the planning record, which is available to the public at the Juneau Ranger District Office.

PURPOSE OF AND NEED FOR ACTION

The purpose of and need for the proposed action is to modify the operator's proposal to develop the Kensington Gold Project. The proposed modifications are necessary to reduce the potential impacts from a mixing zone in marine waters; increase the assurance of meeting water quality standards; minimize the potential impacts to Ophir, Ivanhoe, and Sherman creeks; reduce operational and maintenance requirements and long-term closure liabilities; and increase the economic efficiency of the mine.

The Forest Supervisor for the Chatham Area of the Tongass National Forest is the Responsible Official for this decision. Based on the analysis provided in the SEIS, he may select one of the alternatives discussed herein, select an alternative that combines components of more than one alternative, or select an alternative that includes additional mitigation measures. As cooperating agencies, EPA and the Corps of Engineers will also issue RODs prior to issuing their permits for the Kensington Gold Project.

To assist in identifying issues and concerns related to the proposed modifications to the Kensington Gold Project, the Forest Service, EPA, and Corps of Engineers sent out approximately 360 scoping letters to the public. Two public scoping meetings were held: one was held in Juneau, Alaska, on August 7, 1996, and the other was held in Haines, Alaska, on August 8, 1996. The following significant issues were identified during scoping for the project changes:

- Assurances should be given that the discharges under a National Pollutant Discharge Elimination System (NPDES) permit meet water quality standards.
- The potential for and effects of failure of the dry tailings facility (DTF) should be considered.
- The visual effects on tourism, especially cruise ships and ferries, of the proposed changes should be minimized.
- Use of diesel fuel instead of LPG for power generation may result in increased air emissions.
- The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.

Compliance with other laws is normally guaranteed through a separate permitting process that would commence after a preferred alternative is selected and approved. For the Kensington Gold Project, permits or approvals are required from the following agencies:

- Federal
  - Forest Service (Revised Plan of Operations Approval)
  - EPA (NPDES permit)
  - Corps of Engineers (Section 404 and Section 10 permits)
  - Fish and Wildlife Service (Threatened and Endangered Species Consultation and Bald Eagle Protection Act Compliance)
  - National Marine Fisheries Service (Threatened and Endangered Species Consultation)
- State
  - Division of Governmental Coordination (Coastal Management Program Certification)
  - Department of Environmental Conservation (NPDES and 404 Permit Certification, Air Quality Permit, Solid Waste Permit)
  - Department of Natural Resources (Water Right Permits and Tidelands Permit)
  - Department of Fish and Game (Fish Habitat Permits)
- City and Borough of Juneau (Large Mine Permit).

DESCRIPTION OF ALTERNATIVES, INCLUDING THE PROPOSED ACTION

The Forest Service is required by NEPA to consider alternatives to the Proposed Action that address significant issues identified during the scoping process. The original EIS process broadly considered all issues related to the entire Kensington Gold Project. The FEIS addressed potential options for each project component. Options were then screened to determine their

ability to address significant issues. The options surviving the screening process were used to develop alternatives for detailed consideration in the FEIS.

As discussed previously, the Draft SEIS only addresses the proposed project modifications. Options and alternatives have been developed based on the significant issues identified during scoping for the 1996 Revised Plan of Operations. The following discussion summarizes the project alternatives studied in detail.

Alternative A – No Action

NEPA requires that a No Action Alternative be considered in all environmental documents. For the Kensington Gold Project, the Forest Service No Action Alternative (Draft SEIS Alternative A) is Alternative F, Water Treatment Option 1, as described in the January 1992 Forest Service ROD and modified, as necessary, to address comments provided in the TAR. EPA and the Corps of Engineers have not issued RODs to date. For EPA and the Corps of Engineers, their No Action Alternative would stop project development but would allow limited exploration. This alternative was evaluated fully in the FEIS and the analysis is not repeated in the Draft SEIS.

Alternative A consists of an underground mine; ore-processing facility, including flotation and cyanidation; a tailings impoundment; marine terminal; and ancillary facilities. Both flotation and cyanidation tailings would be managed in the tailings impoundment. Cyanidation tailings would undergo cyanide destruction. Enhanced settling would be accomplished in the tailings impoundment. The effluent from the impoundment would be piped to Lynn Canal for discharge approximately one-half mile offshore north of Point Sherman. Waste rock would be managed in a pile near the 800-foot adit. About 50 percent of the waste rock would be used in construction; the remainder would be permanently managed in the pile.

Alternative B – Proposed Action

Alternative B consists of the operator's proposed action as described in the 1996 Revised Plan of Operations. Modifications to the 1992 Approved Plan of Operations include offsite processing of flotation concentrate and dry tailings disposal at approximately Site B identified in the FEIS. Flotation concentrate would be placed in sealed containers and transported offsite for final processing. At least 25 percent of the flotation tailings would be paste backfilled. The remaining tailings would be managed in the DTF. Mine drainage would undergo precipitation and filtration and be combined with process area runoff in a sediment pond. The sediment pond would discharge to upper Sherman Creek. The DTF would be designed to limit infiltration into the tailings. Waste rock and coarse and fine till would be used in DTF construction. All waste rock generated by the mine would either be used in DTF construction or backfilled. Till would be obtained from a 27-acre borrow area northwest of the process area. DTF seepage and runoff would be collected in a sediment pond and discharged to an unnamed creek. Diesel fuel would be used for power generation. The locations of the helicopter pad, marine terminal, laydown area, and personnel camp are modified from Alternative A.

Alternative C – Marine Discharge

Alternative C is the same as Alternative B, with the exception of marine discharge of mine drainage and pipe transport of diesel fuel from the marine terminal to the process area. Mine drainage would undergo underground settling and then be transported via pipeline towards Lynn Canal. DTF effluent would be combined with the mine drainage. The combined flow would be discharged to Lynn Canal approximately 300 feet offshore north of Point Sherman. The discharge would be through a diffuser and the required mixing zone would be substantially smaller than under Alternative A. Diesel fuel would be transported via an above-ground, double-walled steel pipeline that would generally parallel the haul road from Comet Beach to the process area.

Alternative D – Modified DTF Design

Alternative D is the same as Alternative B, with the exception of a modified DTF design and piping of tailings from the process area to the DTF. Under this alternative, an engineered structural berm would be constructed around all cells of the DTF to enhance geotechnical stability. Tailings slurry would be piped to a dewatering plant at the DTF site. Reclaim water would be piped back to the process area for reuse.

Management, Mitigation, and Monitoring

Environmental management and mitigation measures are designed to ensure that environmental impacts are minimized during construction, operation, and closure of the Kensington Gold Project. In general, the operator has incorporated extensive mitigation into the 1996 Revised Plan of Operations. This includes likely requirements under permits and approvals for the project. Several additional measures have been incorporated into this document. For example, there is a contingency for treatment of DTF effluent if monitoring indicated higher than anticipated pollutant levels in the effluent.

Similar to the FEIS, the operator would coordinate with Federal and State agencies in implementing a broad monitoring program that addresses water resources, air quality, geotechnical stability, and wildlife.

Identification of the Preferred Alternative

The Forest Service, EPA, and the Corps of Engineers have identified Alternative D as the preferred alternative.

Comparison of Alternatives

The alternatives for the proposed modifications to the Kensington Gold Project were compared and evaluated based on the issues identified during the scoping process.

AFFECTED ENVIRONMENT

The FEIS presents extensive information on the environment potentially affected by the Kensington Gold Project. The following additional information was compiled and studies completed to support preparation of the Draft SEIS:

- Acid-base accounting of the ore body indicates low acid generation potential.
- Data from Eldred Rock in the vicinity of the project and regional precipitation data were analyzed to estimate average annual precipitation levels of 47 inches at sea level and 58 inches at the 800-foot elevation.
- Additional hydrologic modeling was performed to revise estimates of average monthly and peak storm event flows throughout the Sherman Creek basin.
- Continued monitoring of ground and surface water quality and stream flows has provided similar results to those presented in the FEIS.
- The small streams in the vicinity of the proposed DTF are ephemeral, and water quality is comparable to Sherman Creek.
- Further studies were conducted of currents in Lynn Canal north of Point Sherman. These studies indicate that eddies influence nearshore water movement. These effects extend as far as one-half mile offshore.
- As discussed in the FEIS, the Point Sherman area is a major commercial fishery. A natural fish barrier approximately 1,000 feet from the mouth of Sherman Creek confines anadromous fish, including pink salmon, to the lowest segment of the creek. Resident Dolly Varden populations occur above the fish barrier. The ephemeral streams in the vicinity of the proposed DTF do not support fish populations.
- The wetlands inventory for the site was expanded. Most of the project area is classified as wetlands. The proposed DTF area is muskeg with dense mats of organic material and saturated soil conditions.
- Socioeconomics data for the Juneau and Haines areas were updated with populations and total employment increasing moderately since 1990. In November 1996, the Juneau population was estimated to be 30,209. The Haines Borough population is 2,373, although the population varies seasonally.

ENVIRONMENTAL CONSEQUENCES

Chapter 4 of the Draft SEIS provides the basis for comparing the alternatives. The chapter discusses the potential environmental effects associated with implementation of the action alternatives compared to the No Action Alternative. The analysis only addresses resources affected by the proposed project modifications. For other resources, the reader is referred to the original FEIS.

Air Quality

The extent of air pollutant concentration increases from all alternatives would be very localized. The emission rates of nitrogen oxides, particulate matter, sulfur dioxide, carbon monoxide, and carbon dioxide would be similar under Alternatives B through D and higher than Alternative A. These higher emission rates would be primarily due to diesel power generation rather than LPG. Under all alternatives, however, combined stack and fugitive emission from all sources would be less than National Ambient Air Quality Standards. Visibility effects would be comparable for all alternatives and would be consistent with the applicable visual quality objectives. Visible emissions under Alternatives B through D would be similar to a cruise ship stack or Juneau's diesel-fired power generating station.

Geotechnical Considerations

The centerline tailings dam construction method under Alternative A has an extremely low potential for failure, based on design standards and experience with many similar existing units worldwide. Avalanche control structures were added to Alternative A in response to the TAR. Under Alternatives B and C, DTF stability would be based on design features to keep the tailings from reaching saturation. However, there is currently a low to moderate risk of widespread saturation occurring that could cause failure. This is primarily because of uncertainty whether design criteria could be achieved in practice and lack of proven examples of similar designs at existing mines. Extensive operational monitoring and pre-designed contingencies would lower the risk of failure during operations. Under Alternative D, an engineered structural berm would be incorporated into the DTF design to minimize the risk of a significant failure if tailings became saturated.

Surface Water Hydrology

All alternatives would have some impact on flows in the Sherman Creek drainage through water withdrawals. Water demands are similar under each alternative: 190 gallons per minute (gpm) for Alternative A and 234 gpm for Alternatives B through D. Under Alternatives B and D, discharge of treated mine water would augment Sherman Creek flows (i.e., limiting flow reductions to the segment between withdrawal and discharge). Under Alternatives A and C, Sherman Creek flows would be reduced by eliminating the existing mine drainage discharge. Under all alternatives, minimum low-flow requirements established by the Alaska Department of Game and Fish (ADF&G) would have to be met. Mine water would be used to provide an alternative water supply for the project.

All alternatives would include stream diversions. Alternative A would include 2.1 miles of diversions of Sherman and Ophir creeks. These streams would be routed across the tailings impoundment at closure. Alternatives B through D would include 2.3 miles of diversions: a shorter diversion of Ophir Creek, a run-on diversion above the process area, and two run-on diversions around the DTF. Under Alternatives B through D, Sherman Creek would not be diverted. The natural drainage, including Ophir Creek, would be restored at the process area at closure. The diversions at the DTF site would be enlarged.

Surface Water Quality

Alternative A would require a mixing zone with 31:1 dilution (a cube approximately 24 feet on a side) to ensure compliance with water quality-based effluent limits for cyanide; several other pollutants would require smaller mixing zones. The location of the outfall one-half mile offshore would address TAR concerns related to the effects of nearshore eddies on mixing. Under Alternatives B and D, fresh water discharges would meet water quality-based permit limits at the discharge point. A nearshore discharge (300 feet offshore) could occur under Alternative C because of a smaller mixing zone requirement, less than 5:1 (a cube approximately 9 feet on a side) only for copper. Offsite processing of sulfide concentrate under Alternatives B through D would virtually eliminate onsite acid generation potential.

The total area of disturbance is comparable under all alternatives. Under Alternative A, the tailings impoundment discharge would be required to meet NPDES permit limits for sediment loadings. This would be accomplished through enhanced settling. Sediment loadings from runoff from construction activities and facilities located outside of the impoundment drainage would be controlled using best management practices (BMPs). Under Alternatives B through D, sediment loadings from the process area would be limited by enhanced settling in a pond. Construction and non-process discharges would be addressed by BMPs. Concurrent reclamation of the DTF and restoration of the remainder of the site to pre-mining conditions to the extent possible would avoid any potential sediment-related impacts after closure.

Alternative A poses water quality-related risks associated with spills of diesel fuel, chlorine, cyanide, and LPG. Alternatives B through D eliminate spill risks from cyanide and chlorine use. There would be an increased risk of a diesel spill.

Ground Water Hydrology and Quality

Under all alternatives, potential hydrogeologic impacts from mine development would be very localized because of the confined nature of the aquifer. Under Alternative A, tailings seepage would be collected and returned to the impoundment during operations. Under Alternatives B through D, any tailings seepage that bypassed the foundation drains would not affect ground water quality because of the inert characteristics of the flotation tailings. As noted above, offsite processing of sulfide concentrate would minimize the acid generation potential. Any accidental spill of diesel fuel could affect ground water quality; however, the probability of a spill is very low under all alternatives. Only Alternative A poses a ground water quality risk associated with cyanide and chlorine.

Aquatic Resources – Marine

As discussed previously, Alternative A would require a mixing zone of 13,700 cubic feet (a cube 24 feet on a side) for cyanide and other parameters. The discharge would be located one-half mile offshore to ensure complete mixing and avoid the nearshore fishing area. Alternative C would require a mixing zone of only 825 cubic feet (a cube approximately 9 feet on a side) for copper, and the discharge could be nearer shore. Discharges under Alternatives B and D would not affect Lynn Canal. Marine spills of cyanide, LPG, diesel, and chlorine could occur under

Alternative A. Under Alternatives B through D, increased diesel transport to the site would be the primary spill concern. The primary risk is associated with transfer from the barge to the shore.

Aquatic Resources – Fresh Water

Alternative A would include a loss of 6,000 feet of habitat in the upper Sherman Creek drainage with fish mortality of 400 to 500 Dolly Varden. Alternatives B through D would temporarily eliminate 2,450 feet of habitat in Ophir Creek with fish mortality of 125 to 170 Dolly Varden. The ephemeral streams that would be disturbed by the DTF do not support fish populations. Under all alternatives, ADF&G minimum low-flow requirements for protection of aquatic life would have to be met. Fresh water discharges of process water under Alternatives B and D would be required to meet water quality-based effluent limitations at the discharge point.

Vegetation and Wetlands

All alternatives would affect vegetation and wetlands. Under Alternative A, approximately 280 acres of vegetation would be disturbed, while Alternatives B through D would disturb between 250 and 270 acres. Under all alternatives, the entire site would be revegetated at closure. During operations, Alternative A would affect about 270 acres of wetlands, while Alternatives B through D would affect between 240 and 260 acres. The tailings impoundment under Alternative A would primarily impact palustrine forested wetlands, while the DTF would affect palustrine scrub-shrub wetlands generally removed from Sherman Creek. Following closure under Alternative A, palustrine wetlands would be allowed to develop on the impoundment, although the physical alteration of the drainage would preclude complete wetlands restoration. Permanent loss of wetlands would occur at the DTF site. As mitigation, ponds would be left as open water.

Visual Resources

Under Alternative A, the primary visual impact would be the tailings impoundment. Under Alternatives B through D, the borrow pits and DTF would have the most significant visual effects. A large portion of the road would also be visible. Reclamation and revegetation of these areas would reduce visibility impacts after closure.

Socioeconomic Resources

Socioeconomic impacts associated with the Kensington Gold Project are primarily driven by population. The peak operation workforce under Alternative A would be about 36 percent higher than under Alternatives B through D. At peak employment, Alternative A would represent about 2.8 percent of the population of Juneau, while peak employment under Alternatives B through D would be about 2.1 percent of the population. Alternative A would have a greater impact on the tight Juneau housing market. Up to 40 Haines residents and 7 Skagway residents could be employed during the operational period of the mine.

Transportation

The primary transportation differences among the alternatives are related to onsite and offsite transport. Alternatives B through D would eliminate the offsite and onsite risk of a cyanide spill. Under all alternatives, virtually no risk of a spill is associated with a barge sinking. Under Alternative A, the risk of spill from fuel transfer from barge to shore is about 1 in 3 over the life of the mine. Under Alternatives B through D, the risk from such transfers is between 1 and 2 spills over the life of the mine. The maximum extent of any spill from a transfer would be 880 gallons. Under all alternatives, onshore fuel storage and transfer would occur in areas with secondary containment. For Alternative A, the risk of a truck accident potentially resulting in a diesel fuel spill is 1 in 7,000 per year. For Alternatives B through D, this risk would be about 1 in 900 per year. The maximum potential spill would be the capacity of the trucks—5,000 gallons. The risk of a diesel pipeline rupture and spill under Alternative C is about 1 in 500 per year with a maximum potential spill of 17,000 gallons. The effects of all spills would be mitigated by prompt spill response.

For tailings transport under Alternatives B and C, the risk of a truck accident and tailings spill would be about 1 in 80 per year with a maximum potential spill of 50 tons. The risk of the tailings pipeline rupture and spill under Alternative D would be about 1 in 700 per year with a total potential release of 270,000 gallons of tailings slurry.

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CHAPTER 1

PURPOSE AND NEED FOR THE ACTION

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1. PURPOSE OF AND NEED FOR PROPOSED ACTION

This Draft Supplemental Environmental Impact Statement (SEIS) was prepared in order to consider a Revised Plan of Operations to develop, construct, and operate a gold mine. Coeur Alaska, Incorporated, a subsidiary of Coeur d'Alene Mines Corporation, is the proponent of the proposed Kensington Gold Project, which would be located on public and private lands in southeastern Alaska.

This Draft SEIS was prepared under the direction of the U.S. Department of Agriculture, Forest Service, Tongass National Forest, which is the lead agency. The U.S. Environmental Protection Agency (EPA) and U.S. Army Corps of Engineers (Corps of Engineers) are cooperating agencies to the Forest Service in preparation of this Draft SEIS (40 CFR 1501.6).

The Chatham Area Forest Supervisor signed the Forest Service Record of Decision (ROD) for the Final Environmental Impact Statement (FEIS) on January 29, 1992. The Kensington Joint Venture, a partnership between Coeur Alaska and Echo Bay Exploration, Incorporated, a subsidiary of Echo Bay Mines Corporation, submitted a Plan of Operations for the Kensington Gold Project in February 1992. On July 17, 1992, the Forest Service approved the Plan of Operations with various conditions, including completion of a reclamation plan and monitoring plan and posting of a reclamation bond. These items were not completed and all of the necessary permits were not obtained from other agencies.

As cooperating agencies, EPA and the Corps of Engineers were responsible for issuing RODs prior to issuing permits. Neither agency issued a ROD or permits. EPA prepared the *Kensington Gold Mine Project, Technical Assistance Report* (TAR) (EPA, 1994) to evaluate potential short- and long-term water quality impacts and potential long-term ecological consequences of the preferred alternative identified in the Forest Service ROD. EPA developed findings and recommendations to assist the Corps of Engineers in determining whether the proposed project would comply with Section 404(b)(1) guidelines of the Clean Water Act. EPA made six recommendations to address its findings:

- Additional wastewater treatment is needed.
- Further analysis of sediment loads in the proposed diversion structures is needed.
- Further analysis and redesign are required to address the avalanche hazard.
- The outfall needs to be moved to deeper water, or more information is needed for the proposed location.
- New leach tests for metals mobility and kinetic testing for potential acid generation are required. Further analysis of residual cyanide and its breakdown products is needed.
- Additional analyses of ore samples are needed to determine whether bulk samples used to project effluent quality are representative of the ore body.

This Draft SEIS discusses the changes recommended in the TAR.

During summer 1995, Coeur Alaska became the sole operator of the Kensington Gold Project. In October 1995, the operator submitted an Amended Plan of Operations for the Kensington Gold Project. The primary modifications include 1) enhanced treatment of tailings effluent with discharge to Sherman Creek, 2) stabilization and backfilling of cyanidation tailings solids, 3) use of diesel generators for onsite power generation, 4) construction of avalanche control structures, and 5) relocation of the laydown and helicopter pad facilities. On October 16, 1995, the Forest Service published a Notice of Intent to prepare an SEIS for the proposed changes to the Kensington Gold Project. Public scoping meetings were held in October 1995.

In response to issues raised during the scoping process and meetings with Federal, State, and local agencies and other interested parties, the operator submitted a Revised Plan of Operations to the Forest Service in June 1996 (i.e., 1996 Revised Plan of Operations). The 1996 Revised Plan of Operations includes:

- Offsite processing of flotation concentrate (no onsite cyanidation)
- Construction of a dry tailings facility (DTF) between Sweeny and Sherman creeks
- Backfill of at least 25 percent of flotation tailings.

All aspects of the operator's proposed operations as they affect National Forest surface resources are subject to a Plan of Operations (36 CFR 228) and Council on Environmental Quality (CEQ) regulations (40 CFR 1500). The SEIS must analyze the direct, indirect, and cumulative impacts associated with the proposed changes to the Plan of Operations. Based on this analysis, the Forest Service may approve the changes to the 1992 Approved Plan of Operations as revised or require the operator to modify its proposal.

The FEIS analyzes the effects of developing the Kensington Gold Project. This Draft SEIS only analyzes the effects of the proposed changes to the 1992 Approved Plan of Operations.

1.1 PURPOSE OF AND NEED FOR PROPOSED ACTION

The purpose of and need for the Proposed Action—amendments to the 1992 Approved Plan of Operations (FEIS)—are to reduce potential impacts from a mixing zone in saltwater; increase assurance of meeting water quality standards; minimize potential impacts to Ophir, Ivanhoe, and Sherman creeks; reduce operational and maintenance requirements; minimize reclamation and long-term closure liabilities; and increase the economic efficiency of the mine.

1.2 RESPONSIBLE OFFICIAL AND DECISION TO BE MADE

The Forest Supervisor for the Chatham Area of the Tongass National Forest is the responsible official for those portions of the project within the jurisdiction of the Forest Service and will document his decision in a ROD based on the analysis presented in this SEIS. The responsible official may make the following decisions:

- Select the No Action Alternative
- Select an action alternative without modification
- Select an alternative that combines project components of more than one alternative
- Select an action alternative and require additional mitigation measures.

1.3 SCOPING AND PUBLIC INVOLVEMENT

As required by the National Environmental Policy Act (NEPA) (CEQ 1501.7), the Forest Service provided for an early and open process to determine the scope of issues to be addressed and to identify significant issues related to the Kensington Gold Project.

The Forest Service mailed approximately 360 scoping letters to the public on July 15, 1996. The letter described the proposed changes to the Plan of Operations and the SEIS process. The letter also announced that public scoping meetings would be held in Juneau, Alaska, on August 7, 1996, and in Haines, Alaska, on August 8, 1996. Advertisements were placed in the *Juneau Empire* newspaper on August 1, 4, and 6, 1996, and the *Chilkat Valley News* in Haines on August 1, 1996, announcing the public meetings.

The public meetings were held at Centennial Hall in Juneau on August 7, 1996, and at the City Council Chambers in Haines on August 8, 1996. Both meetings were open to the public and provided an opportunity for the public to learn about the project and the SEIS process from the Forest Service, EPA, and Corps of Engineers, as well as identify issues they wanted analyzed in the SEIS. In addition, representatives from Coeur Alaska attended the meetings to answer questions about the proposal.

Twenty-seven letters were received from the public in response to scoping. In addition, the previous FEIS and scoping conducted during October and November 1995 were reviewed for issues and comments.

1.4 SIGNIFICANT ISSUES

Significant issues are used to formulate alternatives to the Proposed Action. The following significant issues were identified during the scoping process:

- **Assurances should be given that the discharges under a National Pollutant Discharge Elimination System (NPDES) permit meet water quality standards.** Concerns were raised that the wastewater discharges permitted through the NPDES process meet water quality standards.

- **The potential for and effects of failure of the DTF should be considered.** The risks, liability, and contingencies, as well as environmental effects, of a DTF failure should be discussed.

- **The visual effects on tourism, especially cruise ships and ferries, of the proposed changes should be minimized.** Concerns were expressed that the visual impacts of

the DTF, road, borrow pits, temporary camp, fugitive dust, and diesel emissions from power generation could negatively affect tourism.

- **Use of diesel fuel instead of liquefied petroleum gas (LPG) for power generation may result in increased air emissions.** There is concern that burning diesel fuel, as well as other project modifications, would increase emissions of air pollutants, including carbon dioxide.

- **The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.** The increase in transportation, handling, and use of diesel fuel for power generation could increase the potential for spills.

1.5 OTHER ISSUES

Some issues raised during the scoping process were not considered significant. These issues, therefore, were not used in developing alternatives; however, some were used in evaluating the potential impacts of the alternatives. The following list presents the non-significant issues and the reasons for this classification:

- **The cumulative impacts with other projects in Berners Bay should be considered.** CEQ regulations for implementing NEPA require agencies to consider cumulative impacts when preparing an EIS. These are the impacts on the environment that result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. Therefore, the SEIS is required to consider the cumulative effects of other projects. Because cumulative effects are discussed in this Draft SEIS for all alternatives, this was not considered a significant issue. Chapter 4 considers differences among the alternatives.

- **The location of offsite cyanide or other processing of concentrate should be evaluated.** Coeur Alaska indicated that flotation concentrate would be processed at an existing facility in the United States or another country. If the facility was in the United States, the mill site where the ore concentrate would be processed must be a permitted facility. The concentrate must be processed within the terms and conditions of that permit. If the concentrate was sent to a new facility or an existing facility in the United States not permitted to receive Kensington concentrate, additional permitting and analysis might be required. Such permitting and analysis is beyond the scope of this SEIS.

- **Mine worker safety should be addressed.** The U.S. Mine Safety and Health Administration (MSHA) regulates worker health and safety aspects of mines. Authorized MSHA representatives would inspect the operation routinely and would be involved in educational and safety training. Coeur Alaska would be responsible for providing MSHA with reports of accidents, injuries, occupational diseases, and related data. This issue is outside the scope of this SEIS.

- **The SEIS should evaluate possible transportation changes.** The FEIS considered several transportation options. Transport of workers to the mine by helicopters flying from Juneau's airport was selected as part of the preferred alternative in the ROD. Coeur Alaska has not submitted any proposed changes to this option. If any changes are proposed, the need for additional NEPA analysis would be determined.

- **The socioeconomic evaluation of the FEIS should be updated.** The Forest Service updated the socioeconomic analysis presented in the FEIS for this Draft SEIS. The results of the Draft SEIS socioeconomic analysis are generally comparable to the FEIS and were not considered a significant issue. Chapter 4 discusses differences among the alternatives.

- **The potential should be evaluated for adverse impacts to Sherman Creek from sediment in storm water runoff from borrow pits, the personnel camp, snow disposal areas, and diversion ditches. Riparian areas need to be maintained to minimize sediment input to fresh water.** This issue would be considered during permitting of storm water discharges from these areas and in design of best management practices for sediment control. Chapter 4 discusses differences among the alternatives.

- **The potential for reduction in fish habitat due to water withdrawal should be considered.** This issue would be considered during permitting of water withdrawal by the Alaska Department of Natural Resources. The Forest Service and the Alaska Department of Fish and Game would be consulted. Chapter 4 discusses differences among the alternatives.

- **The potential for adverse effects on fish habit because of undersized culverts should be considered.** This issue would be addressed by site-specific best management practices during road design. Under all alternatives, the culverts would be sized to minimize adverse impacts to fish habitat.

- **EPA must require quality assurance/quality control as part of a monitoring program and provide for periodic splits or duplicate sampling for analysis at an independent laboratory to ensure accuracy of an operator's data.** EPA would consider this during preparation of an NPDES permit.

- **Under all alternatives, the reclamation plan should ensure maintenance or improvement of ground and surface water quality.** The final reclamation plan would meet agency requirements for protection of surface and ground water quality.

- **Site-specific variances should not be granted for mixing zones.** The Alaska Department of Environmental Conservation (ADEC) would consider this issue in its certification of an NPDES permit.

1.6 AGENCY RESPONSIBILITIES (PERMITS AND APPROVALS)

1.6.1 Federal Government

U.S. Forest Service

NEPA Compliance and ROD on Final SEIS
Approval of 1996 Revised Plan of Operations
Section 106 of the National Historic Preservation Act Compliance
Sections 313 and 319 of the Clean Water Act Compliance
Compliance with Executive Orders

The Forest Service is the lead agency in the preparation of the Kensington Gold Project SEIS. The Forest Service's authority to require, evaluate, and approve or modify the operator's 1996 Revised Plan of Operations is based on the 1897 Organic Act, which is described in 36 CFR Part 228. If another agency cannot meet its regulatory responsibilities, the Forest Service is ultimately responsible for ensuring that Federal and State regulations are implemented on National Forest lands.

The Kensington Gold Project would be located in an area currently designated as Land Use Designation II (LUD II) in the Tongass Land Management Plan. This designation allows for mineral activities with the long-term goal of maintaining the wildland character of the area. The proposed revisions to the Tongass Land Management Plan (see Revised Supplement to the Draft EIS [Forest Service, 1996a]) would make the Kensington Gold site a Minerals (MM) area. Minerals development is encouraged in MM areas; however, development must be in an environmentally sensitive manner and limited to the area necessary for efficient, economic, and orderly development. The long-term goal is restoration to the original designation (Modified Landscape [ML]). ML generally allows for resource development and modification to the landscape. Wildlife, fish, and water quality are to be protected.

Prior to approving the 1996 Revised Plan of Operations, the Forest Service must comply with Section 106 of the National Historic Preservation Act (NHPA). Compliance with the NHPA generally involves 1) identification of historic properties that might be affected, 2) assessment of effects to those properties, 3) consultation with the State Historic Preservation Office and interested parties, and 4) comment by the Advisory Council on Historic Preservation if historic properties could be affected.

Under agreement between the Forest Service and ADEC, the Forest Service has committed to fulfilling specific responsibilities to ensure that activities on National Forest lands are consistent with the requirements of Clean Water Act (CWA) Sections 319(b)(2)(f), 319(k), and 313, and Executive Order 12088. Section 319 addresses nonpoint source pollution, and Section 313 and Executive Order 12088 require the Forest Service to adhere to the goals set forth in State water quality standards.

Executive Order 12962 requires Federal agencies to evaluate the potential effects of proposed Federal actions on recreational fisheries. Recreational fishing at the Kensington Gold

Project site is limited. This Draft SEIS complies with Executive Order 12962 by considering the potential impacts of each alternative on water quality, habitat, and transportation. In addition, Executive Order 12898 requires Federal agencies to identify and address disproportionately high and adverse human health or environmental effects of proposed activities on minority and low-income populations. This document addresses Executive Order 12898 by considering the potential impacts of each alternative on such populations.

U.S. Environmental Protection Agency

NEPA Compliance and ROD on Final SEIS
Clean Water Act Compliance
Clean Air Act Compliance
Notification of Hazardous Waste Activity

EPA is a cooperating agency with the Forest Service on the Kensington Gold Project SEIS.

EPA has primary responsibility for implementation of Sections 301, 306, 311, and 402 of the CWA. EPA shares responsibility for Section 404 with the Corps of Engineers.

Sections 301 and 306 of the CWA require EPA to establish numeric limitations or criteria for discharges of water pollutants. Section 301 specifically requires EPA to establish technology-based effluent guidelines for new sources. These criteria must be met at the "end of pipe" where the discharge occurs. The new source performance standards applicable to this facility are described in 40 CFR Part 440.104. In addition, Section 301 requires that all NPDES permits include effluent limitations protective of water quality.

Section 311 of the CWA establishes requirements relating to discharge or spills of oil or hazardous substances. EPA requires each facility that handles substantial quantities of oil to prepare a spill prevention countermeasure and control plan.

Section 402 of the CWA establishes the NPDES program. This program authorizes EPA to permit point source discharges of effluent, including process wastewater and storm water. Discharges must meet all effluent limitations, including water quality-based standards, established under other CWA sections.

In accordance with Section 511(c)(1) of the CWA, NPDES permit actions for new sources are defined as major Federal actions subject to NEPA (40 CFR Part 6, Subpart F). EPA, as a cooperating agency with the Forest Service for this SEIS, will issue a ROD in conjunction with the final permit action.

Section 404 of the CWA authorizes the Corps of Engineers to issue permits for the discharge of dredged or fill materials into waters of the United States. EPA also has authority under Section 404 for reviewing project compliance with Section 404(b)(1) guidelines, Section 404(b) elevation authority, and Section 404(c). Under Section 404(c), EPA may prohibit or withdraw the specification (permitting) of a site upon determination that the use of the site would

have an unacceptable adverse effect on municipal water supplies, shellfish beds, fishery areas, or recreational areas.

The most basic goals of the Clean Air Act are to protect public health and welfare. Section 309 of the Clean Air Act requires EPA to review and comment on EISs. In addition, EPA approves State implementation plans for air quality and reviews Air Quality Control Permit to Operate applications, including prevention of significant deterioration requirements.

U.S. Army Corps of Engineers

NEPA Compliance and ROD on Final SEIS
Section 404 Permit – Clean Water Act (Dredge and Fill)
Section 10 Permit – Rivers and Harbor Act

The Corps of Engineers is a cooperating agency with the Forest Service on the Kensington Gold Project SEIS.

Section 404 of the CWA authorizes the Corps of Engineers to issue permits for discharge of dredged or fill material into waters of the United States. The act prohibits such a discharge except pursuant to a Section 404 permit. To the degree that they affect waters of the United States, various activities undertaken in connection with mining operations could require a Section 404 permit. Such activities include road or bridge construction, construction of dams for tailings storage or water storage, and stream diversion structures.

The Corps of Engineers is responsible for determining whether a proposed action complies with Section 404(b)(1) guidelines. A Section 404 permit cannot be issued without such compliance. Appendix A presents a draft of the Corps of Engineers Evaluation of the Discharge of Dredged and Fill Material in Accordance with Section 404(b)(1) Guidelines, as well as the public notice for the draft 404 permit.

All Federal agencies, including the Corps of Engineers, must comply with Executive Orders 11990 and 11988 with respect to impacts to the Nation's wetlands and/or floodplains. The Corps' regulatory program provides flexibility when considering the national goal of "no net loss" for wetlands. This goal cannot always be achieved on an individual project-by-project basis. The Alaska District of the Corps of Engineers would consider site-specific conditions and impacts when determining the extent of compensatory mitigation required for wetland losses. Wetlands in the area to be affected by the proposed Kensington Gold Project were identified using the Federal Manual for Identifying and Delineating Jurisdictional Wetlands (Federal Interagency Committee for Wetland Delineation, 1989). Of specific note, the Corps of Engineers would regulate the excavation of the wetlands and placement of construction fill at the process area DTF site (under the 1996 Revised Plan of Operations) as fill activity under Section 404. EPA would regulate effluent discharge from the DTF under a Section 402 permit.

Pursuant to the Rivers and Harbors Act of 1899 and Section 103 of the Marine Protection, Research, and Sanctuaries Act, the Corps of Engineers has permitting authority to regulate various activities that affect traditionally navigable waters. Pursuant to Section 10 of the

Rivers and Harbors Act of 1899, a permit is required for any structure or work that could obstruct traditionally navigable waters. The Kensington Gold Project marine terminal would require a Section 10 permit.

U.S. Fish and Wildlife Service

Threatened and Endangered Species Consultation
Bald Eagle Protection Act Compliance

The U.S. Fish and Wildlife Service (USFWS) administers the Endangered Species Act, as reauthorized in 1982, and the Bald Eagle Protection Act of 1940, as amended. For the Kensington Gold Project, the Forest Service must consult with the USFWS regarding any threatened or endangered species that might be impacted by the proposed project. If any impacts are projected, specific design measures must be developed to protect the affected species.

National Marine Fisheries Service

Threatened and Endangered Species Consultation

For the Kensington Gold Project, the Forest Service must consult with the National Marine Fisheries Service in accordance with the Endangered Species Act, the Marine Mammal Protection Act, and the Research and Sanctuaries Act. If any impacts are projected to any threatened or endangered marine species, specific design measures must be developed to protect the affected species.

1.6.2 State and Local Government

Alaska Division of Governmental Coordination

Coastal Management Program Certification

The Division of Governmental Coordination (DGC) administers the Alaska Coastal Management Program (ACMP). DGC coordinates State reviews of activities in the coastal zone involving State and Federal permits. The consistency review provides a streamlined, coordinated process for reviewing and issuing State permits for proposed development projects affecting natural resources and uses in Alaska's coastal zone. In addition to coordinating projects that require State permits, DGC is responsible for coordinating consistency reviews for direct Federal actions (e.g., Corps of Engineers dredging permit) and projects that require Federal permits (e.g., an NPDES permit).

Coastal development projects are reviewed to ensure consistency with the standards of the ACMP, given at 6 AAC 80, and the enforceable policies of approved local coastal district programs. For each project, the ACMP and consistency review regulations provide a structure for public notice, project review, issue resolution, and decisionmaking with the full involvement of State agencies, local coastal districts, and the project applicant.

DGC previously reviewed elements of the Kensington Gold Project and issued a finding (AK820622 01C) on October 30, 1992. This finding indicated consistency with the ACMP. Because proposed changes were submitted, State review of the new project configuration will begin upon receipt of a complete application packet.

Alaska Department of Environmental Conservation

ADEC is responsible for major water and air quality permits associated with the Kensington Gold Project. Under Section 401 of the CWA, ADEC responsibilities include certification of EPA's NDPES permit and the Corps of Engineers Section 404 permit. ADEC must certify that the requirements of these permits would comply with State water quality standards. These standards include designation of the beneficial uses of the water, as well as numerical and narrative water quality criteria established to protect the beneficial uses.

ADEC is responsible for the following major permits, which would be required for the proposed project:

- Section 401 Certification of the Corps of Engineers Section 404 permit
- Section 401 Certification of the EPA NPDES permit
- Engineering review and approval of the sanitary wastewater treatment and disposal systems
- Solid waste permit for the construction, operation, and maintenance of solid waste facilities, including the DTF, and for the management of non-combustible domestic refuse and recyclable goods
- Spill contingency plan
- Air Quality Control Permit to Operate to construct, modify, and operate facilities that produce air emissions.

Alaska Department of Natural Resources

The Alaska Department of Natural Resources is responsible for the following:

- Water rights permits, which authorize the use of surface and subsurface waters of the State and include compliance with instream flow requirements established by the Alaska Department of Fish and Game
- Tideland permit, which is a State lease required for permanent improvements to tidelands
- Right-of-way for marine outfall, barge landing, fuel transfer facility, and concentrate transfer facility.

Alaska Department of Fish and Game

The Alaska Department of Fish and Game is responsible for the following:

- Fish passage and habitat permits for activities that divert, obstruct, or change the natural flows of an anadromous fishery
- Determination of instream flows.

City and Borough of Juneau

The City and Borough of Juneau is responsible for the Large Mine Permit.

CHAPTER 2

DESCRIPTION OF THE ALTERNATIVES, INCLUDING PROPOSED ACTION

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2. DESCRIPTION OF ALTERNATIVES, INCLUDING PROPOSED ACTION

In July 1992, the U.S. Forest Service approved a Plan of Operations (1992 Approved Plan of Operations) for the proposed Kensington Gold Project, located 45 miles north of Juneau, Alaska. The 1992 Approved Plan of Operations included revisions to reflect the Forest Service Record of Decision (ROD) issued for the Final Environmental Impact Statement (FEIS) dated January 29, 1992. The 1992 Approved Plan of Operations reflects the preferred alternative selected by the Forest Service—Alternative F, Water Treatment Option 1. Alternative F consists of underground mining, conventional "wet" tailings disposal, and marine discharge of treated effluent from the proposed operation.

ALTERNATIVES FOR THE KENSINGTON GOLD PROJECT

Alternative A (No Action), FEIS Alternative F, Option 1—Sherman Creek tailings impoundment, marine discharge of impoundment effluent, onsite cyanidation, liquefied petroleum gas (LPG) for power generation

Alternative B (Proposed Action)—Dry tailings facility (DTF) with paste backfill, offsite processing/no onsite cyanidation, fresh water discharge of mine drainage and DTF effluent, diesel fuel for power generation

Alternative C (Marine Discharge)—Similar to Proposed Action, except marine discharge of mine drainage and DTF effluent, diesel pipeline

Alternative D (Modified DTF Design)—Similar to Proposed Action, except construction of an engineered structural berm around DTF, tailings pipeline

During summer 1995, Coeur Alaska, Incorporated, became the sole operator of the Kensington Gold Project. On June 24, 1996, the operator submitted a Revised Plan of Operations (1996 Revised Plan of Operations) and related documentation for the Kensington Gold Project. The most significant revisions to the 1992 Approved Plan of Operations involve ore-processing methods and final disposition of the tailings. Specifically, the 1996 Revised Plan of Operations proposes offsite transport and processing of flotation concentrate, which would eliminate onsite cyanidation. The plan also modified tailings disposal from a conventional wet disposal tailings dam in the Sherman Creek drainage to a "dry" tailings disposal facility located between Sherman and Sweeny creeks.

This Draft Supplemental EIS (SEIS) documents the National Environmental Policy Act (NEPA) process for the 1996 Revised Plan of Operations. Due to previous publication of the FEIS and issuance of the Forest Service ROD in 1992 for Alternative F, Water Treatment Option 1, the No Action Alternative for the Draft SEIS is equivalent to not approving the 1996 Revised Plan of Operations. The Forest Service's No Action Alternative for this Draft SEIS, therefore, comprises the project components of Alternative F, Water Treatment Option 1, as described in the 1992 Approved Plan of Operations, with modifications that address the requirements of the *Kensington Gold Mine Project, Technical Assistance Report* (TAR) (EPA, 1994). U.S. Environmental Protection Agency (EPA) Region 10 prepared the TAR for the U.S. Army Corps of Engineers (Corps of Engineers), Alaska District. The Draft SEIS refers to the No Action Alternative as Alternative A. Alternative B in the Draft SEIS is the Proposed Action. Alternatives C and D in the Draft SEIS modify the Proposed Action based on the scoping process, issue identification, and alternative formulation and analysis.

Unlike the Forest Service, EPA and the Corps of Engineers have not issued individual RODs or permits for the 1992 Approved Plan of Operations. For EPA and the Corps of Engineers, therefore, the No Action Alternative is the original Alternative A as described in the 1992 FEIS. Alternative A in the FEIS would not allow project development but would allow continued mineral exploration. The FEIS fully considers this alternative and, therefore, the Draft SEIS does not evaluate it further.

The alternatives evaluated in the Draft SEIS focus primarily on mineral processing, tailings disposal, wastewater management, the location for effluent discharge, and fuel source selection. After publication of the FEIS, the operator conducted additional studies on baseline hydrology, water quality, aquatic life, and soil conditions and provided study data to the Forest Service, EPA, and Corps of Engineers to support identification and evaluation of feasible project alternatives and mitigation measures.

This chapter presents the four alternatives for the Kensington Gold Project: Alternative A - No Action, Alternative B - Proposed Action, Alternative C - Marine Discharge, and Alternative D - Modified DTF (dry tailings facility) Design. Section 2.1 discusses significant issues raised during the scoping process and alternatives development. Section 2.2 provides an overview of each alternative. Section 2.3 discusses the alternatives by project component, and Section 2.4 describes the components not studied in detail. Section 2.5 describes relevant mitigation measures and monitoring. Section 2.6 identifies the preferred alternative. The chapter concludes with Section 2.7, which compares the alternatives.

2.1 ISSUES AND ALTERNATIVES DEVELOPMENT

Formulating alternatives to the Proposed Action is an important component of the NEPA process. By identifying issues during the scoping process and formulating alternatives to the Proposed Action, the lead Federal agency (i.e., Forest Service) can alter or lessen the magnitude of potential environmental impacts associated with the Proposed Action.

Alternatives developed for the SEIS reflect the significant issues identified during scoping for the SEIS, including the following:

- Assurances should be given that the discharges under a National Pollutant Discharge Elimination System (NPDES) permit meet water quality standards.
- The potential for and effects of failure of the DTF should be considered.
- The visual effects on tourism, especially cruise ships and ferries, of the proposed changes should be minimized.
- Use of diesel fuel instead of liquefied petroleum gas (LPG) for power generation may result in increased air emissions.
- The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.

Alternatives C and D were developed specifically to address the significant issues identified during the scoping process associated with the 1996 Revised Plan of Operations. Table 2-1 summarizes the development of alternatives in response to issues identified during scoping.

Table 2-1. Development of Alternatives in Response to Scoping Issues

Issues	Alternative A	Alternative B	Alternative C	Alternative D
1. Use of diesel for power generation and resulting air emissions, including carbon dioxide	Liquefied petroleum gas (LPG)	Diesel	Diesel	Diesel
2. Potential impacts to water quality, fisheries, and other resources caused by spills when storing, handling, and transporting diesel fuel	LPG	Truck transport of diesel from beach to process area	Diesel fuel piped from beach to process area	Truck transport of diesel from beach to process area
3. Potential impacts to visual quality and the effects on tourism, especially cruise ships and ferries	Tailings impoundment	DTF; some backfill of tailings; till borrow area required for construction	Same as Alternative B	Same as Alternative B
4. Potential for and impacts associated with failure of the DTF	No DTF	Engineered drainage system for DTF; contingencies for instability	Same as Alternative B	DTF modified to include engineered structural berm around outer shell
5. Potential impacts to water quality at outfall 001 (upper Sherman Creek) and outfall 002 (Unnamed Creek)	Marine discharge from tailings pond to Lynn Canal	Discharge to Sherman Creek (outfall 001) and Unnamed Creek (outfall 002); precipitation/ filtration of mine drainage and enhanced settling in ponds	Marine discharge of mine drainage and DTF effluent to Lynn Canal; discharge of process area runoff to upper Sherman Creek	Same as Alternative B

2.2 OVERVIEW OF PROJECT ALTERNATIVES

This section introduces the four alternatives for the Kensington Gold Project. Section 2.3 provides a more detailed discussion of each alternative by project component. Figures 2-1 through 2-4, provided after Section 2.2, present layouts and summaries of Alternatives A through D, respectively.

2.2.1 Alternative A – No Action Alternative

Alternative A assumes that none of the proposed 1996 revisions to the 1992 Approved Plan of Operations would be implemented. This alternative serves as the baseline for estimating the potential effects of the other alternatives and project components. NEPA requires that a No Action Alternative be considered in all environmental impact analyses. In this instance, the No Action Alternative consists of Alternative F as identified in the FEIS and selected by the Forest Service in the 1992 ROD and modified to address TAR requirements.

Alternative A would include an underground mine, an ore-processing facility, tailings impoundment, office and maintenance complex, onsite employee camp, two heliport/helipads, a marine terminal on Comet Beach, and other ancillary facilities. Other facilities include an access road from the marine terminal to the mine, a fuel storage area, and an explosives magazine.

During full production, the Kensington Gold Project would process approximately 4,000 tons of ore per day. Ore would be mined by the underground extraction technique of long hole, open stoping. An estimated 400 tons of waste rock per day would be hauled to the surface using a conveyor system and stored in a 15-acre pile at the mill. Approximately 50 percent of the waste rock would be used in construction of the tailings embankment, road, and facility foundations. About 920,000 tons of waste rock would require permanent management in the pile.

Ore would be mined and sent to underground jaw crushers. The crushed ore then would be transported to the surface. At the surface, the crushed ore would be ground and passed through a flotation circuit, in which the gold-bearing minerals would be separated from barren rock. Gold would be recovered from the flotation concentrate by tank cyanidation methods to produce gold bullion. Cyanidation tailings would be treated with chloride to destroy cyanide. Both flotation and cyanidation tailings would be pumped to the tailings pond.

Flocculation and baffles would be used to enhance settling in the tailings pond. Tailings water would be recycled from the pond to the maximum extent possible, and excess water would be discharged via a pipeline to Lynn Canal. The marine discharge would be located one-half mile offshore north of Point Sherman. Ophir Creek would be diverted around the tailings impoundment in an open, concrete-lined channel, and avalanche control structures would be constructed in the Ophir Creek drainage. Upper Sherman Creek would be diverted through a culvert.

Reclamation would comprise restoring the site to its pre-mining land use of wildlife habitat and recreation. All buildings, structures, storage tanks, and roads would be removed from the site, except the tailings impoundment. All disturbed areas, including the tailings impoundment, would be regraded to blend with the natural topography to the maximum extent possible. These areas then would be covered with growth media and seeded. Upper Sherman Creek and South Fork Sherman Creek would be routed across the east end of the tailings impoundment into a pond adjacent to the Ophir Creek diversion. The pond would discharge to the Ophir Creek diversion, where the combined flows would fall through a spillway to lower Sherman Creek. All channels would be designed to carry the probable maximum flood.

2.2.2 Alternative B – Proposed Action

Alternative B represents the operator's formal proposal to modify the 1992 Plan of Operations. The modification was proposed to enhance the project's constructability, operability, reclamation, and long-term post-closure monitoring and maintenance, as well as to minimize potential impacts to water quality.

Alternative B involves offsite transport and processing of flotation concentrate, construction of the DTF, and backfilling of tailings. The flotation concentrate would contain the majority of the sulfide component of the ore. The concentrate would be dewatered, filtered, and loaded into specially designed, sealed marine transport containers. Barge shipments would occur weekly, weather permitting, to an existing offsite location for gold recovery operations.

Flotation tailings would be either backfilled in the mine or deposited in the DTF. At least 25 percent of the tailings would be backfilled using paste backfill techniques. The thickened tailings would be pumped to a paste backfill plant in the mine, combined with water and cement, and gravity fed into mined out areas. In addition, waste rock would be backfilled into selected areas within the mine.

Tailings to be deposited in the DTF would be dewatered and transported by truck to the DTF site (i.e., Site B identified in the FEIS). The DTF would be constructed in three stages or cells. Tailings would be placed in 28-foot lifts or layers. Each lift would be covered with a 2-foot layer of till and waste rock. The outer slopes and top of the DTF would receive a final cover of till and growth media. Till would be obtained from a borrow area near the mill. Waste rock would be stored temporarily in a 15-acre pile at the 800-foot adit. All waste rock generated during the life of the mine is expected to be used in DTF construction or backfilled.

Mine drainage would undergo precipitation and filtration and then be combined with process area runoff in a settling pond. Discharge from the settling pond would be to upper Sherman Creek. Runoff and seepage from the DTF would be collected in a settling pond and discharged to Unnamed Creek. Wastewater from the milling process would be recycled. The DTF would require the diversion of a series of unnamed streams that terminate near Comet Beach. Ophir Creek would be diverted around the process area.

The personnel camp would be located directly west and adjacent to the process area, farther removed from the main access road than under Alternative A. Diesel fuel would be transported by barge to the site and trucked to the generators at the mill site.

Reclamation would consist of restoring the site to its pre-mining land use of wildlife habitat and recreation. All buildings, structures, and storage tanks would be removed from the site. All disturbed areas, including roads, would be regraded to blend with the natural topography and seeded to the maximum extent possible. The borrow pits would be graded to support the development of wetlands. The settling ponds would be retained as open water. The original channel of Ophir Creek would be restored. The diversion channels around the DTF would remain in place and be redesigned to carry a 500-year, 24-hour storm event. The DTF would undergo concurrent reclamation as cells were developed. This would reduce the extent of

disturbance in the project area over the life of the project. Appendix B presents relevant sections of the reclamation plan that were submitted as part of the Proposed Action.

2.2.3 Alternative C – Marine Discharge

Alternative C is similar to Alternative B, except that mine drainage and DTF effluent would be discharged to Lynn Canal, and diesel fuel would be transported from Comet Beach to the process area via a double-walled steel pipeline. Mine drainage would not receive treatment beyond underground settling. Mine drainage would be piped from the process area toward Lynn Canal and be combined with effluent from the DTF settling pond prior to discharge. The operator would need to apply for a mixing zone from the State of Alaska to comply with NPDES permit limits. The effluent pipeline would extend 300 feet into Lynn Canal from Comet Beach. The discharge would be through a diffuser located 30 feet below the low-tide level. Process area runoff would be collected in a settling pond and discharged to upper Sherman Creek. Diesel fuel would be transported by an above-ground, double-walled steel pipeline that would generally parallel the road from Comet Beach to the process area.

2.2.4 Alternative D – Modified DTF Design

Alternative D is similar to Alternative B, except the DTF design would be modified. Under Alternative D, the most significant modification is construction of an engineered structural berm around the exterior shell of the DTF. The berm could be constructed of waste rock, tailings, and/or other appropriate material. Alternative D also includes an above-ground tailings slurry pipeline and dewatering facility at the DTF. An additional diesel generator would supply power for the dewatering facility at the DTF. Reclaimed water would be pumped back to the mill.

2.3 PROJECT COMPONENTS STUDIED IN DETAIL

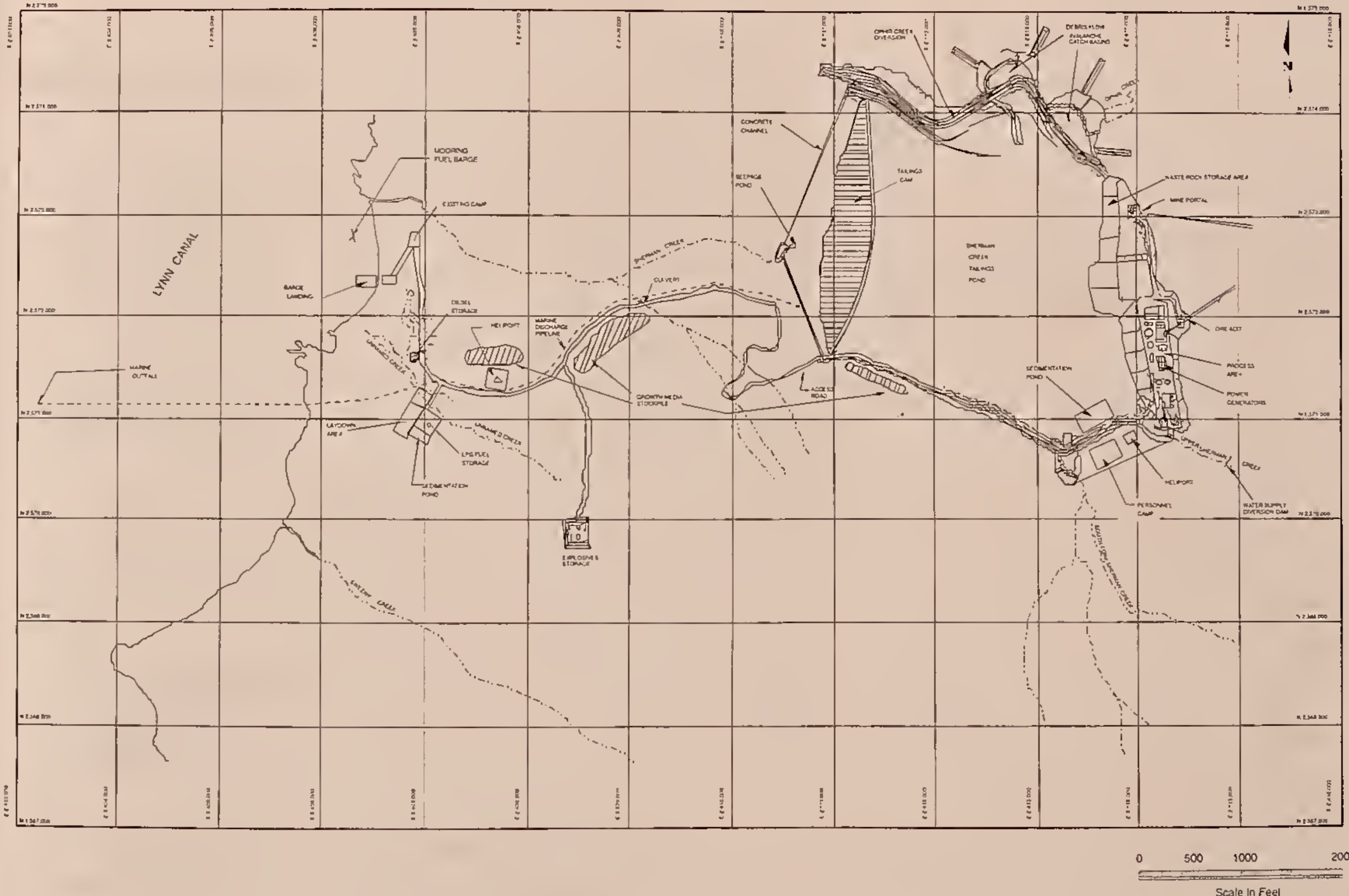
This section discusses the alternatives by the different project components, including waste rock disposal, ore processing, water management, and tailings disposal.

2.3.1 Project Location

The overall proposed project location is the same as the location identified on page 2-4 of the FEIS.

2.3.2 Mining Methods

The proposed mining methods are similar to those presented in the 1992 Approved Plan of Operations. Pages 2-5 through 2-7 of the FEIS discuss proposed mining methods. Sections 2.3.3 and 2.3.6 of this document discuss the role of paste backfill in mining.



ALTERNATIVE A COMPONENTS

Waste Rock	400 tons of rock per day, stored in a 15-acre pile at mill site, about 50 percent used in tailings embankment, road, and foundation construction.
Ore Processing	Underground crushing, surface grinding, flotation, and cyanidation.
Tailings Management	Wet tailings disposal in an impoundment in Sherman Creek, no backfill. No haul road.
Diversions	100-year, 24-hour diversions of Ophir and Sherman creeks.
Wastewater	Enhanced settling in impoundment, effluent from impoundment piped to marine discharge point 1/2 mile off shore in Lynn Canal north of Point Sherman.
Employee Transportation	Helicopter from Juneau airport.
Supply Transportation	Barge to Comet Beach.
Power Supply	2 LPG generators at mill, one LPG generator at beach.
Employee Housing	Onsite personnel camp south of Sherman Creek.
Borrow Area	Sand and gravel quarries near the process area (130 acres) within impoundment drainage.
Reclamation	Restore to previous use, wildlife habitat and recreation, remove structures, regrade and revegetate, route streams over tailings impoundment.

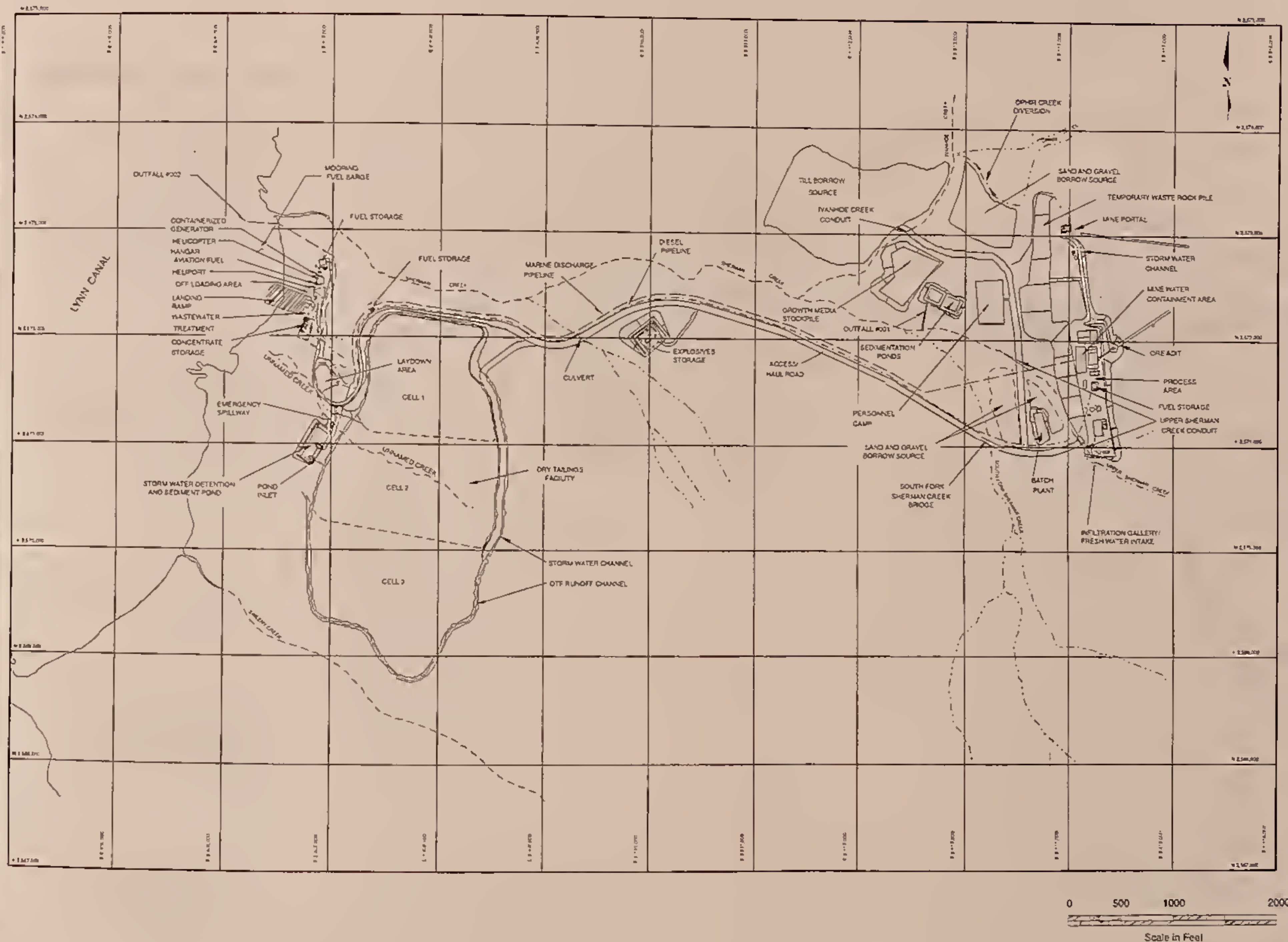
Figure 2-1
Kensington Gold Project
Alternative A

2140-31

ALTERNATIVE B COMPONENTS

Waste Rock	Temporary 15-acre pile at mine portal, all used in DTF construction and backfill.
Ore Processing	Underground crushing, surface grinding, and flotation, offsite transport of flotation concentrate for further processing.
Tailings Management	Placement of dry tailings in the DTF, engineered drainage system, paste backfill minimum of 25 percent of all tailings, tailings trucked to DTF. 60-foot wide haul road from mill to DTF.
Diversions	100-year, 24-hour diversion above the DTF. 100-year, 24-hour Ophir Creek diversion around mill site.
Wastewater	Fresh water discharges to Sherman and Unnamed creeks at outfalls 001 (mine water and process area runoff) and 002 (DTF effluent), enhanced settling in ponds, precipitation/filtration of mine drainage
Employee Transportation	Helicopter from Juneau airport.
Supply Transportation	Barge to Comet Beach.
Power Supply	Four diesel generators at mill, one diesel generator at beach, diesel trucked to the process area
Employee Housing	Onsite personnel camp north of Sherman Creek.
Borrow Area	Sand and gravel quarries near the process area (16 acres total), till borrow area (27 acres) west of the sand and gravel quarry.
Reclamation	Restore to previous use, wildlife habitat and recreation, remove structures, regrade, and revegetate, maintain diversion above DTF-increase to 500-year, 24-hour capacity.

Figure 2-2
Kensington Gold Project
Alternative B

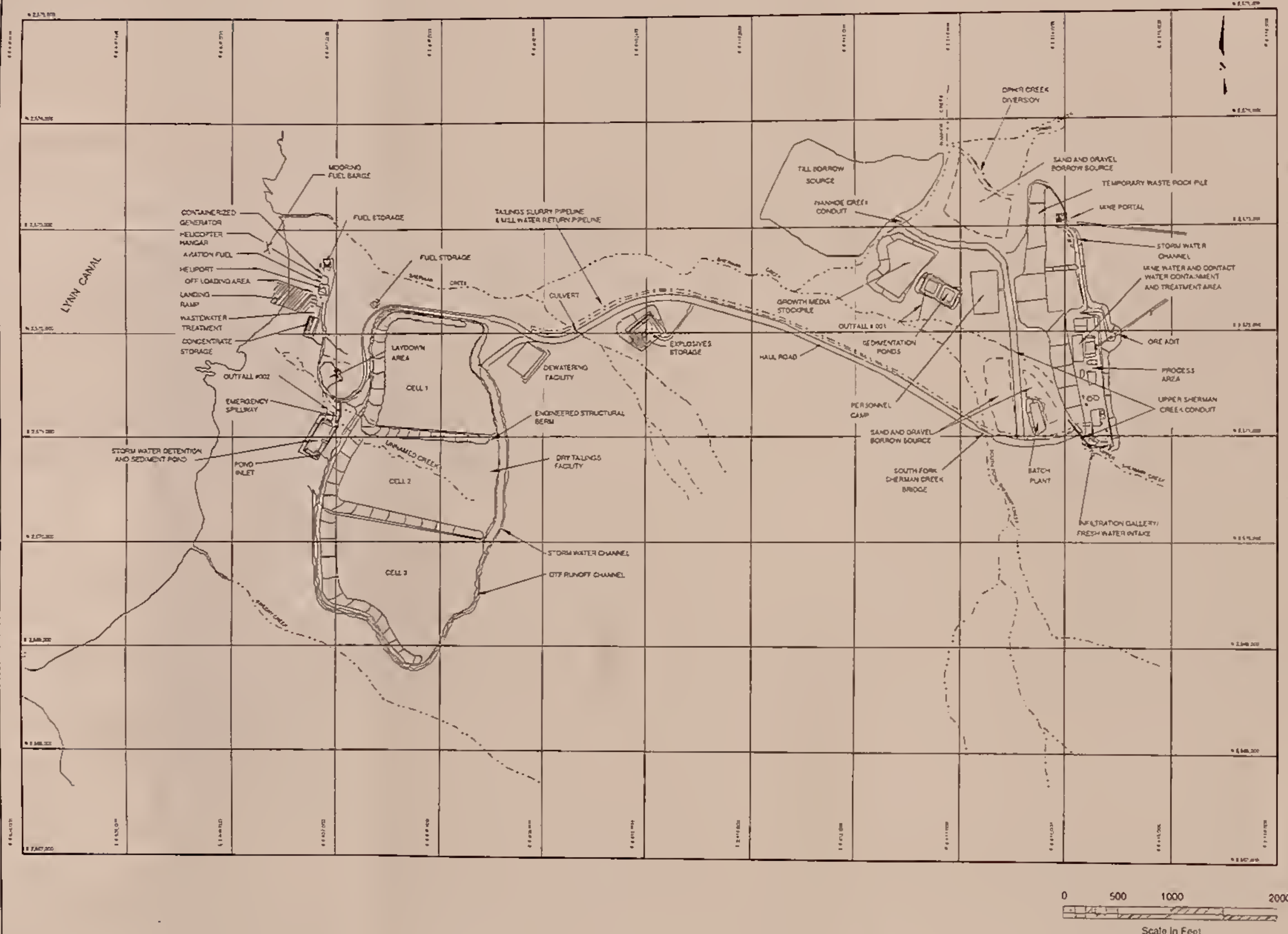


ALTERNATIVE C COMPONENTS

Waste Rock	Temporary 15-acre pile at mine portal, all used in DTF construction and backfill.
Ore Processing	Underground crushing, surface grinding and flotation, offsite transport of flotation concentrate for further processing.
Tailings Management	Placement of dry tailings in the DTF, engineered drainage system, paste backfill minimum of 25 percent of all tailings, tailings trucked to DTF, 60-foot wide haul road from mill to DTF.
Diversions	100-year, 24-hour diversion above the DTF. 100-year, 24-hour Ophir Creek diversion around mill site.
Wastewater	Marine discharge of mine drainage and DTF effluent to Lynn Canal 300 feet offshore at outfall 002. Discharge of process area runoff to upper Sherman Creek at outfall 001. Enhanced settling in ponds.
Employee Transportation	Helicopter from Juneau airport.
Supply Transportation	Barge to Comet Beach.
Power Supply	Four diesel generators at mill, one generator at beach, diesel piped to the process area.
Employee Housing	Onsite personnel camp.
Borrow Area	Sand and gravel quarries near the process area (16 acres total), till borrow area (27 acres) west of the sand and gravel quarries.
Reclamation	Restore to previous use, wildlife habitat and recreation, remove structures, regrade, and revegetate, maintain diversion above DTF-increase to 500-year, 24-hour capacity.

Figure 2-3
Kensington Gold Project
Alternative C

214D-33



ALTERNATIVE D COMPONENTS

Waste Rock	Temporary 15-acre pile at mine portal, all used in DTF construction and backfill.
Ore Processing	Underground crushing, surface grinding and flotation, offsite transport of flotation concentrate for further processing.
Tailings Management	Placement of dry tailings in the DTF, engineered structural berm around all cells, paste backfill minimum of 25 percent of all tailings, tailings slurry piped from mill to DTF, 60-foot wide haul road from mill to DTF.
Diversions	100-year, 24-hour diversion above the DTF, 100-year, 24-hour Ophir Creek diversion around the process area.
Wastewater	Fresh water discharges to Sherman and Unnamed creeks at outfalls 001 (mine drainage and process area runoff) and 002 (DTF effluent), precipitation/filtration of mine drainage. Enhanced settling in ponds.
Employee Transportation	Helicopter from Juneau airport.
Supply Transportation	Barge to Comet Beach.
Power Supply	Four diesel generators at mill, one diesel generator at beach, one generator at the DTF, diesel trucked to the mill.
Employee Housing	Onsite personnel camp
Borrow Area	Sand and gravel quarries near the process area (16 acres total), till borrow area (27 acres) west of the sand and gravel quarries.
Reclamation	Restore to previous use, wildlife habitat and recreation, remove structures, regrade, and revegetate, maintain diversion above DTF-increase to 500-year, 24-hour capacity.

Figure 2-4
Kensington Gold Project
Alternative D

2.3.3 Waste Rock Disposal

Waste rock is rock with a gold content below the economic processing grade that must be removed to develop underground facilities and to access the ore. Waste rock must be disposed of at a stable and suitable site. Under all the alternatives, the operator anticipates the production of approximately 270 cubic yards (400 tons) of waste rock per day, with an annual production of approximately 100,000 cubic yards (150,000 tons). The projected total waste rock for the life of the mine is about 1.2 million cubic yards (1.8 million tons). All alternatives would require that the waste rock be mined and moved to the surface using a conveyor system. The *Technical Resource Document for Water Resources, Kensington Gold Project* (SAIC, 1997) presents the results of chemical characterization studies for the waste rock, as well as ore and tailings.

Under Alternative A, waste rock would be managed in a pile (approximately 15 acres) within the tailings impoundment drainage area near the mine entrance. It would then be used in road, tailings dam, and other embankment construction and for riprap and reclamation activities. Approximately 612,000 cubic yards (920,000 tons) of waste rock would have to be managed permanently in the pile.

Under Alternatives B through D, waste rock also would be stockpiled temporarily near the mine entrance and would be used in DTF construction and in selected mine backfill areas. Construction of the DTF and backfilling are expected to use virtually all of the waste rock produced during the life of the mine. Waste rock would be used in DTF base drain construction, as well as placed as drainage layers between lifts. Under Alternative D, waste rock could also be used in construction of the berm around the DTF. The temporary stockpile of waste rock at the mine entrance would be approximately 15 acres; however, the waste rock only would be stockpiled for the first 3 to 4 years of the project. Subsequently, the supply of waste rock would essentially equal the demand, and waste rock only would be stored at the DTF for very short periods. Waste rock would not be used in any site construction activities other than the DTF.

2.3.4 Ore Processing

Once mined, ore must be processed to recover the gold. Ore processing under all alternatives includes underground primary crushing facilities, surface grinding facilities, and a mill flotation process. Pages 2-7 and 2-8 of the FEIS discuss this process. Treatment of the flotation concentrate differs among the alternatives.

As described on pages 2-8 through 2-10 of the FEIS, Alternative A includes onsite cyanidation of flotation concentrate using carbon-in-leach (CIL) gold recovery methods. The CIL process would generate approximately 1.2 million tons of tailings (i.e., 4 to 7 percent of the total volume of tailings produced at the site). Residual cyanide in the CIL tailings would be destroyed by alkaline chlorination. Gold recovery would be performed as described in the FEIS.

Under Alternatives B through D, the underground primary crushing facilities, surface grinding facilities, and the mill flotation process would be the same as Alternative A. The crushed concentrated ore would not be treated using a cyanide CIL process, however, but would

be containerized and transported offsite for final processing. Figure 2-5 compares the ore-processing circuits from the Forest Service ROD (i.e., Alternative A) and the 1996 Revised Plan of Operations (i.e., Alternatives B through D).

The FEIS evaluates offsite processing of the flotation concentrates, but not in detail. Recent advances in dewatering techniques and the availability of offsite processing capacity have now made offsite processing feasible for the Kensington Gold Project. Under Alternatives B through D, ore concentrate would be dewatered, filtered, and loaded into specially designed $4 \times 8 \times 20$-foot marine transport containers for offsite gold-recovery processing. The sealed containers would be delivered to Comet Beach by truck and stored outside on a storage pad (100 $\times$ 200 feet) adjacent to the barge off loading area (see Figures 2-2 through 2-4, presented previously). On average, one 1,400-ton load would be shipped by barge on a weekly basis.

The types and volumes of chemicals used for grinding and flotation would be the same as those detailed in the FEIS (see Table 2-2 on page 2-14). Because gold would be recovered offsite, Alternatives B through D would eliminate the use of chemical reagents for cyanidation and cyanide destruction.

2.3.5 Water Management

Under Alternative A, a tailings dam would be constructed across Sherman Creek. All mine drainage and process water from the site would be managed in the Sherman Creek tailings impoundment. The tailings impoundment would capture precipitation that occurs on the impoundment area, as well as contain runoff from the process area. This catchment would be approximately 225 acres.

Flocculation and baffles would be used to enhance settling in the tailings pond. Water would be reclaimed to the maximum extent practicable from the tailings impoundment for reuse in the mill. Excess water in the tailings impoundment would be piped to Lynn Canal for discharge north of Point Sherman. The discharge would require a mixing zone to comply with NPDES permit requirements and Alaska water quality standards, as discussed in Chapter 4 of the FEIS. Alternative F, Option 1, in the FEIS includes a marine discharge approximately 300 feet offshore at a depth of 30 feet. After issuance of the TAR, the operator conducted additional studies on circulation patterns in the vicinity of Point Sherman. As discussed in Section 3.9 of this Draft SEIS, eddies form near the shore north and south of Point Sherman. These eddies extend to about one-quarter to one-half mile offshore and to a depth of approximately 100 feet. To ensure adequate mixing and dispersion of the plume from the marine outfall, therefore, the discharge under Alternative A would be located about one-half mile offshore at a depth of 300 feet. The discharge would also be outside of the near-shore fishing area. The operator would install a multiport diffuser at the discharge point.

Under Alternative A, approximately 2.1 miles of stream diversion channels would be constructed. Upper Sherman Creek flows, including flows from South Fork Sherman Creek entering Sherman Creek from the southeast, would be diverted from the south side of the tailings

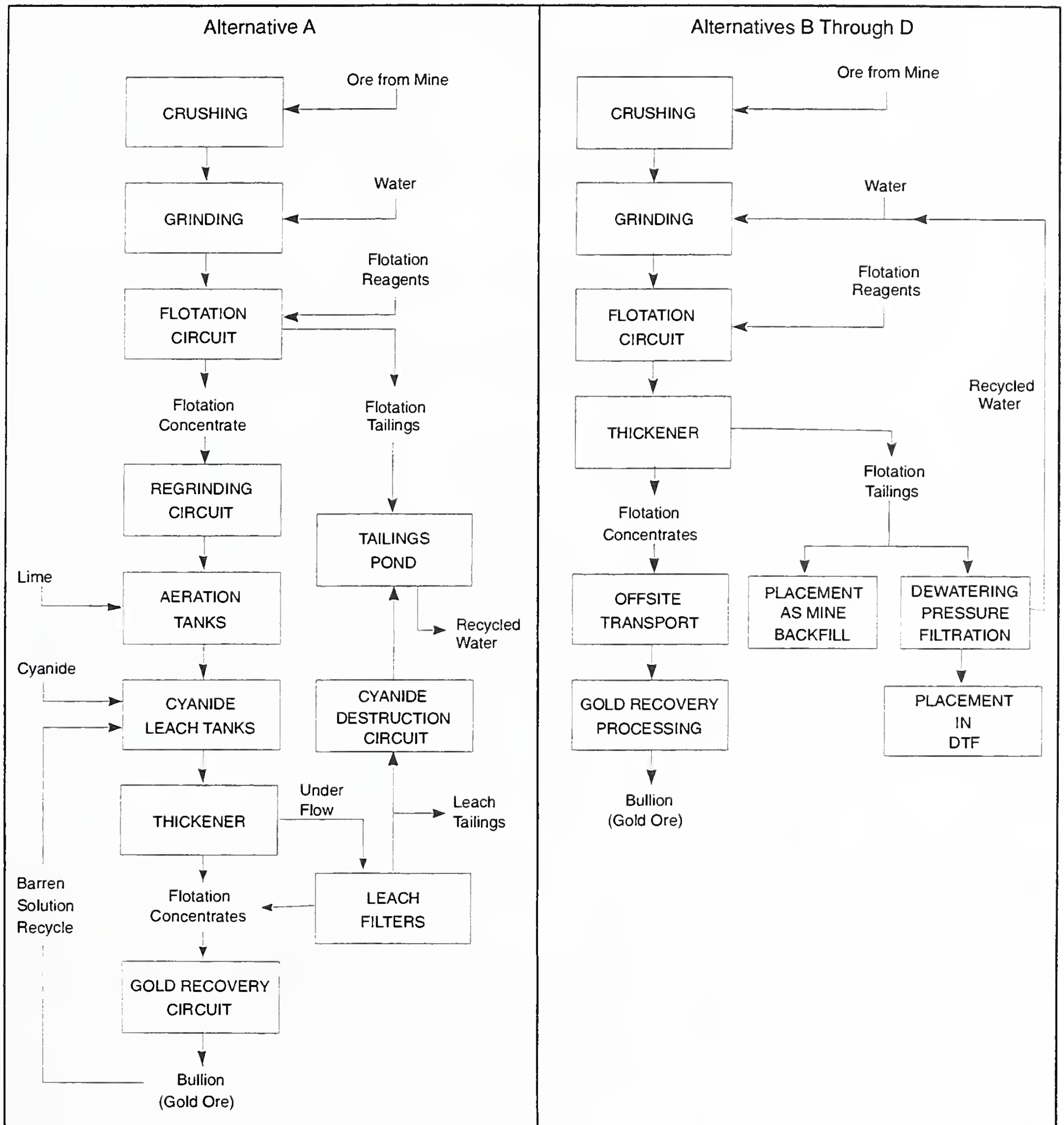


Figure 2-5
Comparison of Ore-Processing Circuits for Alternative A and Alternatives B Through D

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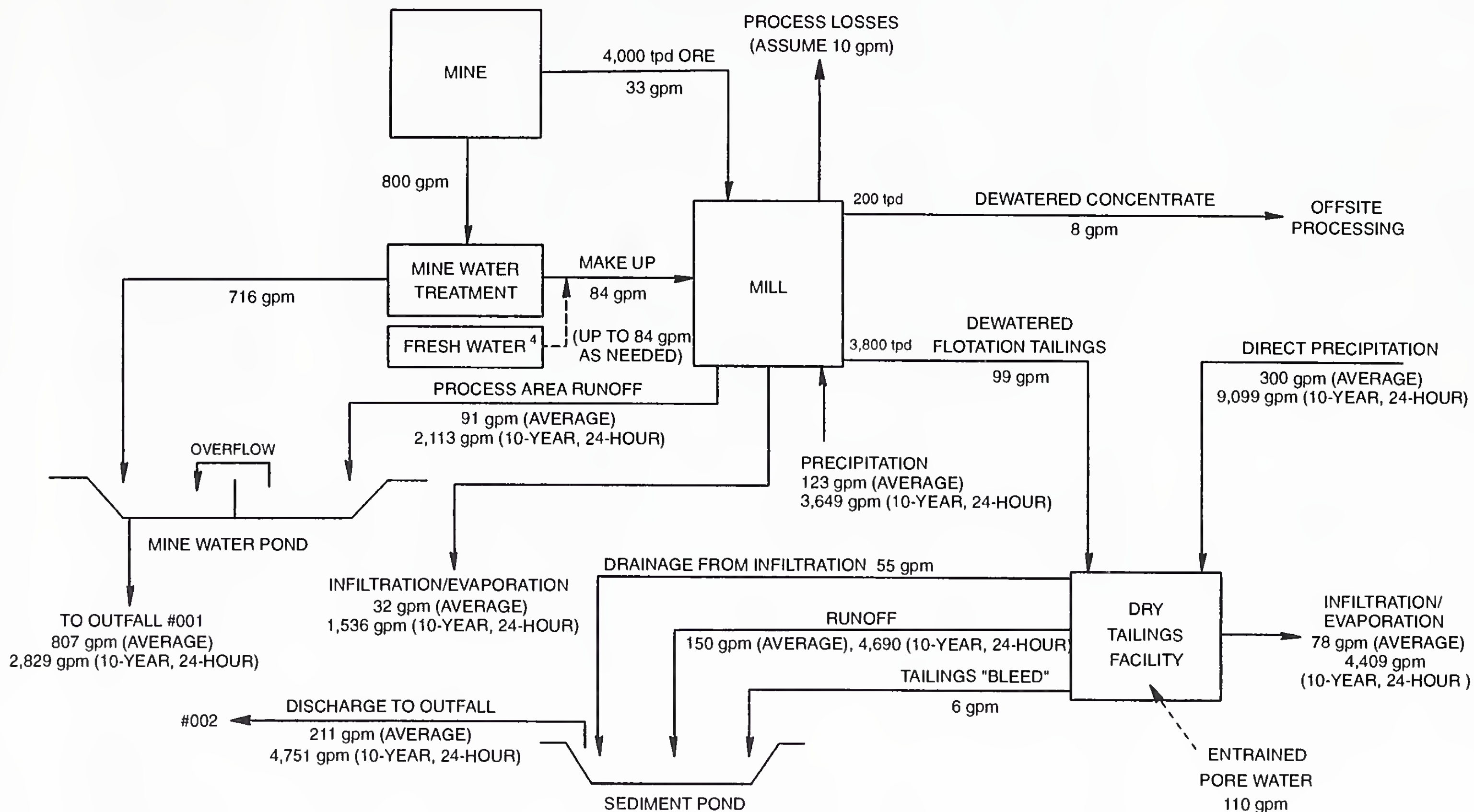
impoundment via a buried pipeline. This pipeline would be designed to convey the 25-year, 24-hour storm event. An Ophir Creek diversion would be designed to route flows around the tailings impoundment through a concrete-lined channel. The Ophir Creek diversion would be designed to convey the probable maximum flood. It would return diverted flows to Sherman Creek below the impoundment via a concrete spillway. The Ophir Creek spillway would require a design to ensure proper energy dissipation to avoid scouring or alteration of the channel at the point of entry into Sherman Creek. The operator would construct avalanche control structures in the Ophir Creek drainage upslope from the diversion.

Under Alternative A, a small diversion dam on upper Sherman Creek primarily would supply fresh water for the mill circuit, domestic uses, and power supply. Total water supply demands for the project would average 190 gallons per minute (gpm) (0.42 cfs). As discussed on page 2-24 of the FEIS, fresh water demands for the mill circuit, domestic use, and power supply and mining operations are estimated as 48 gpm (0.11 cfs), 35 gpm (0.08 cfs), and 107 gpm (0.24 cfs), respectively. To meet these requirements, the operator previously applied to the Alaska Department of Natural Resources (ADNR) for the right to increase water removal from upper Sherman Creek from 0.1 cfs to about 1.1 cfs. This request was never finalized due to the 1996 project modifications. For all alternatives, the operator would be required to meet ADNR permit requirements for maintaining minimum low flows in Sherman Creek that are protective of aquatic life. Under all alternatives, mine drainage would also be used at the process area for make-up water, including during low-flow periods and for initial startup, after temporary shutdowns, and/or following maintenance activities. The operator has also applied to ADNR to remove up to 1,449 gpm (3.3 cfs) from the mine. The generation of mine drainage is expected to generally range from 600 gpm (1.4 cfs) to 1,000 gpm (2.3 cfs). Under all alternatives, the operator has applied for an ADNR-permitted water withdrawal of 50 gpm (0.125 cfs) from an unnamed creek to provide domestic water for Comet Beach facilities.

Under Alternatives B through D, an infiltration gallery upstream of the process area in Sherman Creek primarily would supply fresh water. The infiltration gallery would feed a 300,000-gallon fresh water tank. The total water supply demands for the project under Alternatives B through D would average 234 gpm (0.52 cfs). The fresh water demands for the mill circuit, domestic use, and power supply and mining operations are estimated at 84 gpm (0.19 cfs), 50 gpm (0.11 cfs), and 100 gpm (0.22 cfs), respectively. To meet these requirements, the operator recently applied to ADNR for the right to increase water removal from upper Sherman Creek from 0.1 cfs to a maximum of about 0.7 cfs. The operator also applied to ADNR to pump up to 49 gpm (0.1 cfs) from an upper Sherman Creek tributary. As noted previously, the operator would be required to meet ADNR permit requirements for maintaining minimum low flows in the Sherman Creek drainage that are protective of aquatic life.

Figure 2-6 presents the water balance for Alternatives B through D, including both average monthly flows and extreme storm event conditions. Mine drainage would be collected and settled underground and then pumped to the surface. Under Alternatives B and D, the drainage would then undergo precipitation and filtration. Pages 2-12 through 2-15 of the FEIS describe available wastewater treatment technologies for metals and solids. As discussed in Chapter 4 of this Draft SEIS, the proposed precipitation and filtration system would meet



NOTES:

1. BASED ON AVERAGE ANNUAL PRECIPITATION OF 58.3" ON TYPICAL FACILITY OPERATIONAL CONFIGURATION.
2. BASED ON HELP MODEL RESULTS.
3. VARIES FROM 600 - 1,000 gpm; MINE WATER USED AS MAKE-UP FOR MILL AS NEEDED.
4. MINE WATER PRIMARY MAKE-UP FOR MILL; FRESH WATER ONLY USED AS NECESSARY.

10-YEAR, 24-HOUR = FLOWS RESULTING FROM 10-YEAR, 24-HOUR STORM EVENT.

Figure 2-6
Site Operational
Water Balance

(Source: Modified from SRK, 1996d)

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NPDES permit limits without a fresh water mixing zone. Figure 2-7 illustrates the proposed treatment system. Under Alternatives B and D, the treated mine drainage would be combined with process area runoff in a settling pond prior to discharge to upper Sherman Creek. Process area runoff includes runoff from five sources: the mill site, temporary waste rock pile, sand and gravel borrow areas, till borrow access road, and personnel camp. The pond would be designed to detain storm water runoff and allow settling of sediment for storms up to the 100-year, 24-hour event. Under Alternative C, mine drainage would be settled underground and piped from the process area toward Lynn Canal. The pipeline would be south of Sherman Creek, as shown in Figure 2-3, presented previously. Under Alternative C, process area runoff would be managed in the settling pond at the mill site and discharged to upper Sherman Creek.

Under Alternatives B through D, seepage and runoff from the DTF would be captured in a storm water channel totaling 8,481 feet (1.6 miles) around the DTF. The runoff would be routed to a settling pond designed to detain storm water runoff and allow settling of sediment for storms up to the 100-year, 24-hour event. Under Alternatives B and D, the DTF settling pond would discharge to Unnamed Creek. Under Alternative C, DTF effluent would be piped north across the haul road and be combined with the mine drainage pipeline. The combined flow would be discharged to Lynn Canal. All effluent pipelines would be "double pipe" systems for spill prevention. The inner pipe would be constructed of high density polyethylene (HDPE) or steel. Regardless of the material used for the inner pipe, the outer pipe would be cased with HDPE. Assuming that the State granted a mixing zone, the discharge would be through a multiport diffuser located 300 feet from shore at a depth of approximately 30 feet below the low-tide elevation. The pipeline would be buried in a trench surfacing at the diffuser. A location just south of Sherman Creek was selected because the water in this area reaches a depth of 30 feet closest to the shoreline. This would minimize the length of the pipeline. The minimum depth of 30 feet below the low-tide elevation was selected to ensure that the discharge would be submerged under all conditions. In addition, the discharge would be beyond the coarse material found near the shore, which could affect diffuser operations. The small size of the mixing zone under Alternative C (a cube 9 feet on a side) compared to Alternative A (a cube 24 feet on a side) would allow a near-shore discharge without potential impacts on aquatic life. Sections 4.6.1 and 4.6.4 present detailed discussion on the sizing of the mixing zone for Alternatives A and C. The final location of the outfall and the size of a mixing zone, if any, would be determined by the Alaska Department of Environmental Conservation (ADEC) and EPA under the NPDES permitting process if this alternative is selected. If the State did not grant a mixing zone, additional treatment comparable to the mine drainage treatment system under Alternatives B and D probably would be necessary to meet NPDES permit limits.

Under Alternatives B through D, polymers would be added to the process area and DTF settling ponds as necessary to enhance settling. Runoff from the till borrow area would be collected in an unlined detention pond within the borrow area. Surface discharges to adjacent wetland areas would only occur during a 100-year, 24-hour event via a spillway. Runoff from haul roads would be managed using best management practices (BMPs) and discharged at NPDES-permitted outfalls to wetland areas.

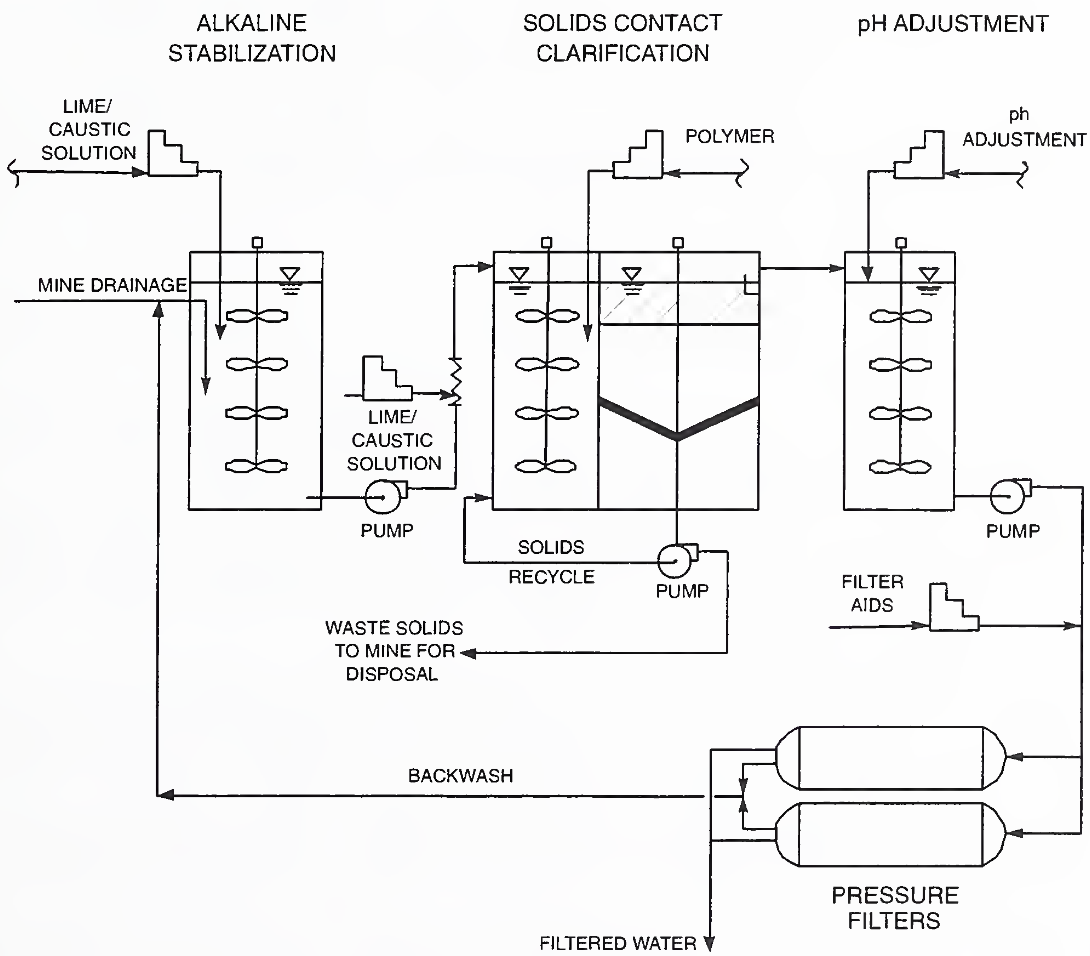

Figure 2-7
Chemical Precipitation Treatment
for Alternatives B Through D

(Source: SRK, 1996d)

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Under Alternatives B through D, two diversion channels would be constructed in the vicinity of the process area in the Sherman Creek basin. The first channel would be a storm water diversion constructed to catch surface runoff from the watershed east of the process area. The channel would route captured runoff south to join upper Sherman Creek. The storm water diversion would be blasted bedrock or rip-rap channel. The estimated length of the diversion is 2,992 feet (0.5 miles). The second channel would be a stream diversion constructed to divert flows from Ophir Creek around a borrow area, the haul road, and a growth media stockpile. This diversion would route Ophir Creek, as well as runoff generated in the Ophir Creek sub-basin, west to Ivanhoe Creek at approximately the 670-foot elevation. This diversion, which would be similar in design to the first diversion, would be 862 feet (0.2 miles) long. The diversion channels would be designed to route flow from the 100-year, 24-hour storm event during operations. Under Alternatives B through D, the layout of the process area, including borrow sites, would minimize the extent of stream diversions.

In addition, two storm water diversion channels would be constructed above the DTF under Alternatives B through D. The first diversion would provide drainage from a 58-acre sub-basin routing flows south and then west around the embankment before converging with Unnamed Creek. This diversion would be a rip-rap or a blasted bedrock design with a length of approximately 3,678 feet (0.7 miles) (SRK, 1996b). The second diversion would provide drainage from a 90-acre sub-watershed and route flows north and then west to another unnamed creek. This diversion also would be a rip-rap or a blasted bedrock design with an estimated length of 4,522 feet (0.9 miles). The diversion channels would be designed to route flow from the 100-year, 24-hour storm event during operations.

The haul road would require five stream crossings under Alternatives B through D. As shown in Figures 2-2 through 2-4, culverts would be required where the haul road crosses an intermittent unnamed tributary below the explosives storage area, and a new bridge would be constructed on South Fork Sherman Creek to replace the existing bridge. Two crossings would be constructed on upper Sherman Creek and one on Ivanhoe Creek using low-profile, bottomless arch conduits. These crossings would be 380, 300, and 200 feet in length, respectively, and would be designed to pass flows from a 100-year, 24-hour storm event and maintain the integrity of fish habitat. The *Technical Resource Document for Water Resources* (SAIC, 1997) and *Kensington Gold Project, Report on Construction Activity Related to Creek Crossings and Alterations* (SRK, 1996h) present detailed discussion of the design of these crossings.

2.3.6 Tailings Disposal

The operator estimates that the Kensington Gold has an ore reserve of about 20 million tons, although the exact size is difficult to predict. If the ore reserve is larger and additional tailings produced, sufficient tailings disposal capacity would be required. Pages 2-15 through 2-20 of the FEIS consider both wet and dry tailings disposal. The FEIS analyzes wet tailings disposal at one location in upper Sherman Creek (which was selected in the Forest Service ROD) and two locations in Sweeny Creek. In addition, the FEIS addresses dry tailings disposal at two locations: Sites "A" and "B."

Technological innovations during the past 5 years suggest that partial backfilling of tailings and dry tailings disposal at Site B are now feasible alternatives. Dry tailings disposal is now feasible for the following reasons:

- Ore does not have to undergo regrinding prior to gold recovery, thereby producing a coarser material than would be generated with onsite cyanidation.
- Dry tailings disposal has been used successfully worldwide during the past 5 years (Coeur Alaska, 1996a).
- Tailings produced are relatively inert (i.e., no cyanide is added and the sulfide content is low), thereby minimizing wastewater treatment requirements.

Alternative A would use wet tailings disposal, which is consistent with Alternative F in the FEIS. Alternatives B through D would use dry tailings disposal; the remainder of this section discusses this type of disposal.

Tailings Dewatering and Management

Under Alternatives B through D, flotation tailings would be thickened to approximately 55-percent solids. Under Alternatives B and C, the thickener overflow would discharge to the mill water tank, and underflow would be pumped to two filter feed tanks at the mill site. Plate filters (or design equivalent) would dewater the flotation tailings to filter cake with 15- to 18-percent moisture content (dry weight). The filtrate would be recycled completely as process water. The filter cake would be transferred to covered trucks and transported to the DTF for placement. The operator would construct a 60-foot wide haul road from the process area to the DTF to meet Mine Safety and Health Administration (MSHA) requirements.

Alternative D includes an 8,000-foot tailings slurry pipeline from the mill to a dewatering facility located near the DTF. Tailings would flow from the thickeners to an agitative tank and then by gravity through the pipeline. The pipeline would parallel the access/haul road in a 10-foot wide right-of-way (see Figure 2-4, presented previously). The tank would have an 8-hour maximum holding capacity. The tailings pipeline would be 14-inch HDPE with a 20-inch casing for spill containment. Flow sensors would be used to detect any blockages or breaks, and an automatic shutdown mechanism would activate as necessary. The dewatering facility would have the same configuration as under Alternatives B and C. The dewatered tailings would be conveyed to a covered transfer area prior to loading into trucks from which the tailings would be placed in the DTF. Reclaimed water would be piped back to the mill through a steel or HDPE pipeline parallel to the slurry pipeline for recycling. Construction of the pipelines would eliminate the 80 haulage trips per day for tailings. The haul road specifications under Alternative D would be the same as for Alternatives B and C, because waste rock and till borrow material would be transported to the DTF site.

Dry Tailings Facility Operation

Under Alternatives B through D, dry tailings would be placed in the DTF. The overall footprint of the DTF under Alternatives B and C would be about 104 acres. The DTF would be constructed in stages (i.e., cells)—cell 1 (33 acres), cell 2 (40 acres), and cell 3 (41 acres). Each cell would have 5 to 7 lifts of tailings. Under Alternative D, construction of an engineered structural berm could increase the area of disturbance by up to 18 acres.

Under Alternatives B through D, the operating scenario for the DTF involves construction of an initial drainage system following clearing, stripping, and stockpiling of surficial materials. As shown in Figure 2-8, the drainage system would be herringbone design with drains spaced at about 100-foot intervals. The drains would be filled with gravel from the construction of the terminal area at Comet Beach. The gravel would be wrapped in geotextile materials to ensure integrity. Prior to initial tailings placement, a minimum of 2 feet of development rock would be placed over the foundation drains. Any areas of the ground that were unsuitable for direct waste rock placement would be covered with geofabric prior to rock placement. Tailings then would be placed in uncompacted lifts approximately 28-feet high. Placement would occur across the entire width of the cell, advancing in an easterly direction. Tailings would not be stored temporarily at the process area or DTF beyond the limited surge capacity in the dewatering system and transfer areas. Therefore, tailings would be either placed directly in the DTF or backfilled (see below) at all times under all weather conditions. Each DTF lift would be covered with a 2-foot layer comprising 1 foot of compacted low permeability fine till material (a barrier) and 1 foot of waste rock to provide immediate cover and a working surface. The waste rock stockpile for each cell would be located in the footprint of the next cell to be constructed. Figure 2-8 shows the development sequence of the DTF, and Figure 2-9 provides typical cross sections and cover details.

As sections of each lift were filled completely, the exposed tailings on the surface of the cell would be covered immediately by the till and waste rock layers, thereby minimizing exposure to precipitation and infiltration. Generally, the tailings area exposed to direct precipitation would be less than 5 acres. Tailings seepage and runoff from the active areas of the cells, as well as runoff from reclaimed areas, would be directed to the DTF settling pond prior to discharge. The pond would be about 350 feet × 150 feet × 14 feet in depth, with a capacity of about 13 acre-feet. The pond would be sized to handle drainage for the entire DTF area of disturbance. As the tailings were placed in each lift, a compacted tailings shell would be constructed around the perimeter of each lift. The thickness of this shell would vary from 35 feet at the base of each cell to 12 feet at the top of each cell. The shell primarily would provide a working surface for capping and reclamation of the outer surfaces of the DTF.

Under Alternatives B through D, the outer slopes and top of the DTF would receive a final cover. The final cover would comprise 6 to 8 feet of fine and coarse till. The underlying fine till layer would serve as a hydraulic barrier, while the overlying coarse till layer would be a drainage layer for infiltration. Growth media would be placed over the coarse till to support revegetation.

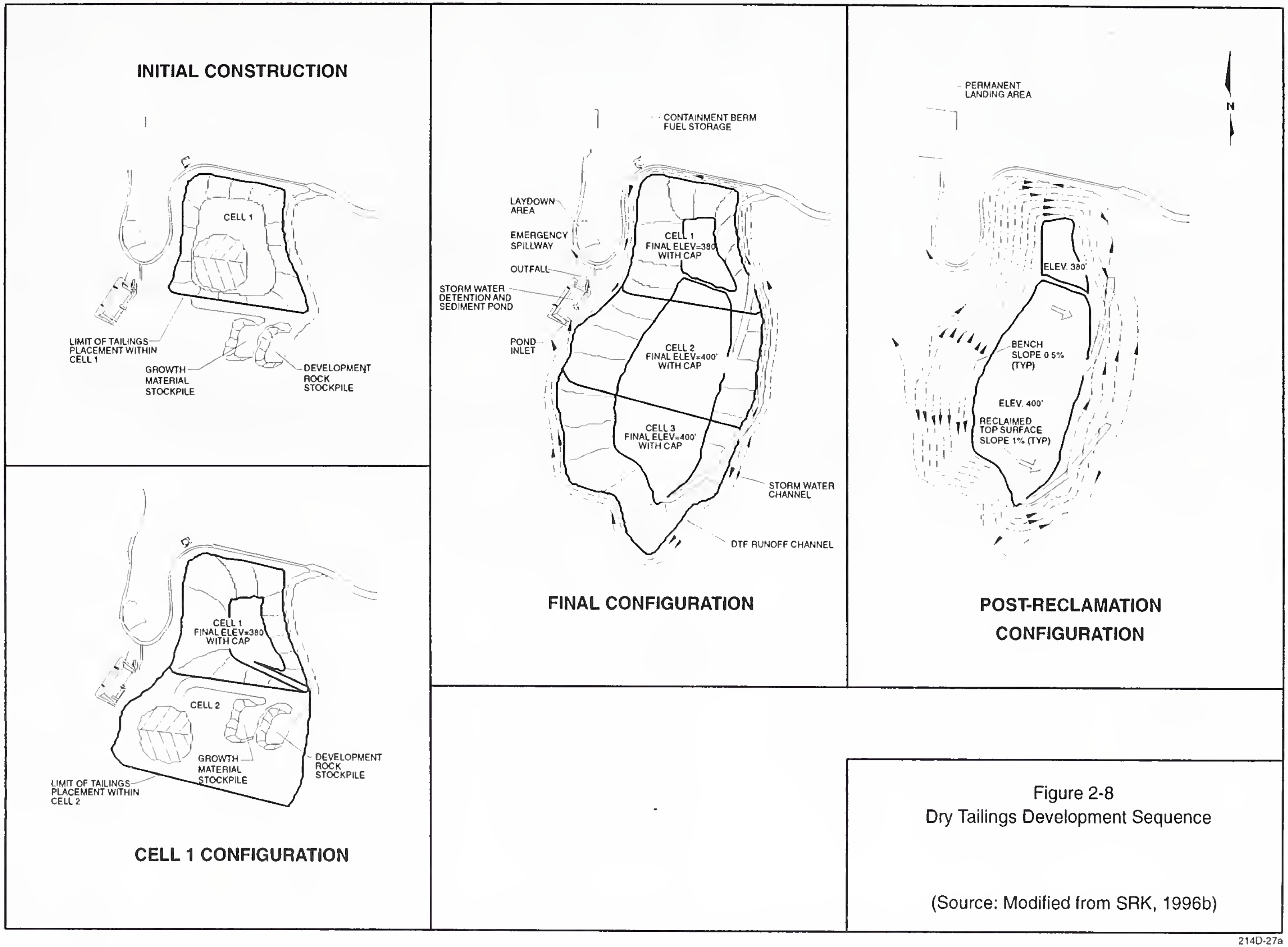

Figure 2-8
Dry Tailings Development Sequence

(Source: Modified from SRK, 1996b)

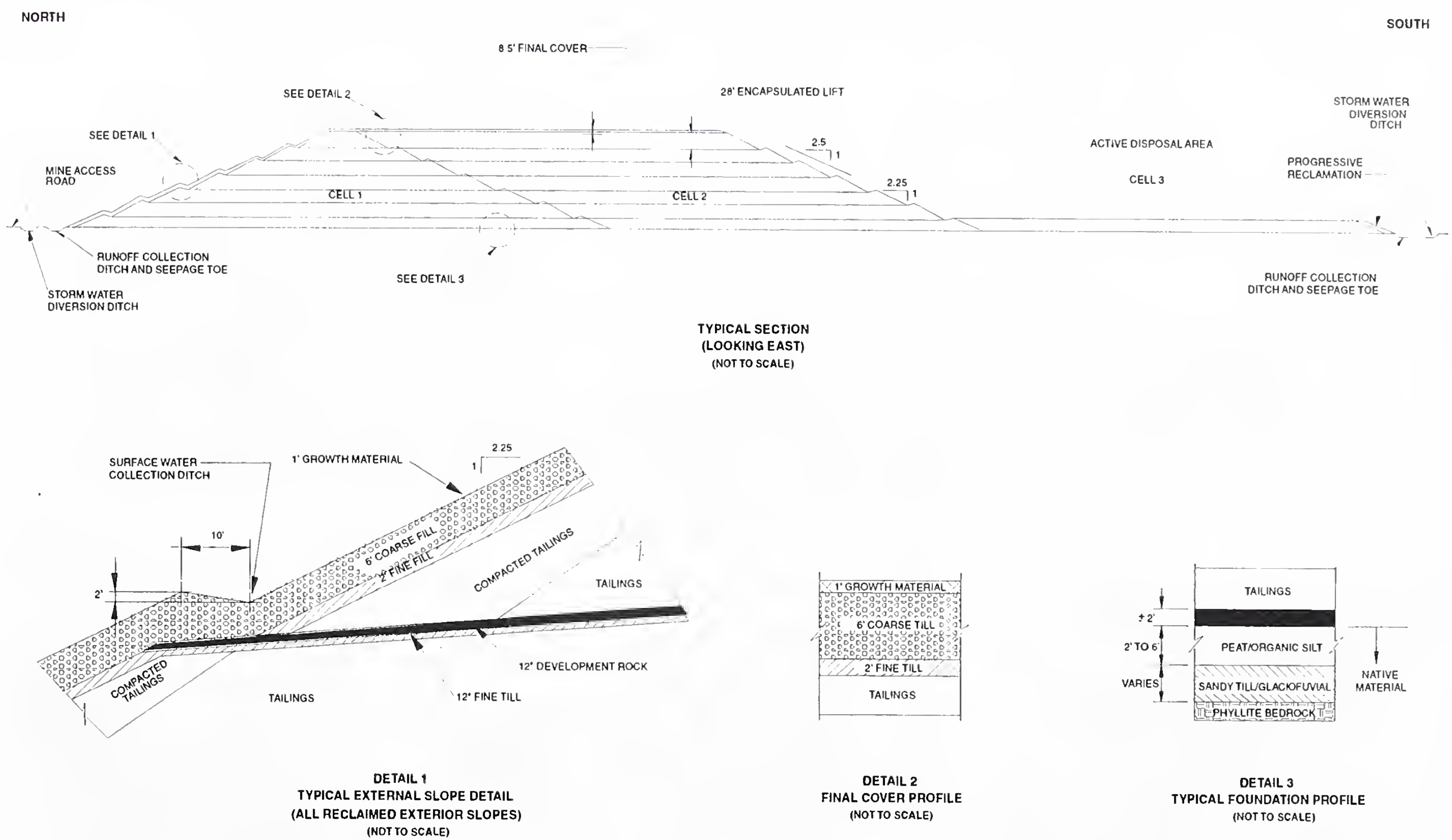

Figure 2-9
Dry Tailings Facility
Typical Section and Cover Details

(Source: SRK, 1996b)

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Specific operational procedures, quality assurance/quality control requirements, and monitoring plans would be incorporated into the DTF design and final Plan of Operations. Instrumentation, including thermistors, piezometers, and lysimeters, would be used to monitor water levels and potential saturation, which affect geotechnical stability. If monitoring data indicated that widespread saturation were occurring, Alternatives B and C would include a contingency to construct an engineered structural berm around the DTF using waste rock, compacted tailings, or other suitable material.

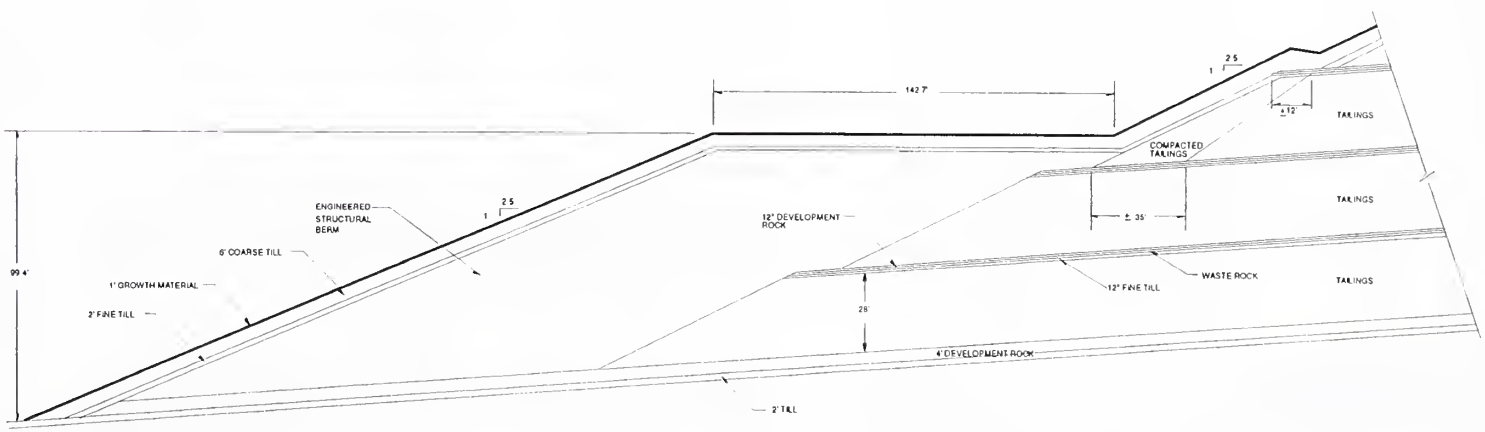
Alternative D consists of a modified DTF design similar to Alternatives B and C, with the same infrastructure, construction, operation, and closure as specified in the 1996 Revised Plan of Operations. As mentioned previously, Alternative D would require the construction of an engineered structural berm around all cells. It would be constructed concurrent with the initial tailings lifts of each cell. The footprint of the berm, shown in Figure 2-4, presented previously, could increase the total area disturbed by up to 18 acres. Figure 2-10 provides a cross section at the west toe of the berm. The berm as currently designed would extend to a height of about 100 feet along the west slope and about 50 feet on the north and south slopes. The footprint along all four sides would provide for extension of the berm to the top of each cell if operational monitoring demonstrated the potential for instability in the upper lifts of each cell.

Backfill

The FEIS eliminates partial backfilling of tailings from consideration because of potential instability in the underground workings. New paste backfilling techniques have evolved during the past 5 years that would allow the operator to backfill while maintaining stability within the mine workings. The FEIS also indicates that backfilling of CIL tailings might cause acid drainage. Alternatives B through D include offsite processing and, therefore, CIL tailings would not be produced onsite. The operator performed additional acid-base accounting studies that show that flotation tailings have a low acid-generating potential.

Under Alternatives B through D, the operator would transport at least 25 percent of the tailings to a paste backfill plant. Thickened tailings would be pumped to the backfill plant at 55-percent solids through a 6-inch diameter HDPE or steel pipeline. The pipeline would extend 1,500 feet from the thickeners to the 800-foot portal and adit. The pipeline then would extend down the 800-foot adit to the middle of the ore body. At this point, the pipeline would rise through a borehole to the paste backfill plant at the 2,050-foot level. A catchment would be provided underground to contain the total volume of tailings slurry flowing underground. At the portal, the pipeline would have a check valve to prevent backflush to the surface. On the surface, the pipeline would be sited in a containment ditch that would provide secondary containment for any ruptures and spills. The return water line from the paste backfill plant to the mill would parallel the tailings line with the same containment measures.

At the paste backfill plant, the tailings would be mixed with water and cement and piped by gravity into open stopes within the mine. Testing completed by the operator shows that paste material could be placed efficiently and remain stable throughout the life of the mine. Backfilling selected open slopes would allow areas to be mined that otherwise could not be excavated due to stability concerns.



COMPACTED ENGINEERED STRUCTURAL BERM DETAIL
(NOT TO SCALE)

Figure 2-10
Cross Section of
Engineered Structural Berm
(West Toe) - Alternative D

(Modified from: SRK, 1996e)

214D-50

Due to swelling and mixing with water and cement, the operator theoretically could paste backfill all of the open stopes in the mine with only about 60 percent of the tailings volume produced at the Kensington Gold Project. Since paste backfill cannot be pumped, the volume of backfill would be limited to areas that could be accessed from the backfill plant by gravity feed. In addition, certain areas along the outer edges of the ore body would not be economical to paste backfill. These areas would either be backfilled with waste rock or remain open. The operator's estimate of 25-percent backfill was based on these considerations. Therefore, the Draft SEIS does not consider a higher percentage of backfill in detail.

2.3.7 Employee Housing and Transportation

Except for the location of the permanent personnel camp, employee housing and transportation would be the same as discussed on pages 2-20 through 2-24 of the FEIS. Under Alternatives B through D, the proposed camp would be located directly west and adjacent to the process area, which is north of upper Sherman Creek (see Figures 2-1 through 2-4, presented previously).

2.3.8 Power Supply

To supply power under Alternative A, five 3.5-megawatt (MW) turbine generators fueled by liquefied petroleum gas (LPG) would be located at the site with three units operating at a time (see page 2-25 of the FEIS). Under Alternatives B through D, diesel-powered reciprocating generators would be used. Four 3.33-MW diesel generators would be located at the process area, and a 275-kilowatt (kW) "containerized" unit would be located near Comet Beach. These generators would supply the estimated annual 68.4-MW site demand. Alternative D would require installation of an additional generator at the DTF to supply power to the dewatering facilities.

For diesel-fired generators, a selective catalytic reduction system or similar best available control technology would be used to control emissions of nitrogen oxides as required by ADEC. Under all alternatives, the power supply would be operated and emission sources controlled according to ADEC air quality permit requirements.

2.3.9 Fuel Use and Storage

Under all alternatives, a shore-based platform raft with secondary containment systems would be used to transfer fuel from the barges, as discussed on pages 2-25 and 2-26 of the FEIS. Diesel fuel would be stored onsite in above-ground tanks with berms and liners for secondary containment.

Alternative A would use 2 million gallons of diesel fuel per year. Alternative A would include two primary diesel fuel storage areas: a 150,000-gallon tank at the marine terminal and a 20,000-gallon tank at the process area. Diesel fuel would be trucked to the tank at the process area.

Under Alternatives B through D, an estimated 6.5 million gallons of diesel fuel would be used annually. One 300,000-gallon tank would be located near Comet Beach, and one 300,000-gallon tank would be located at the laydown area. At the process area, two 20,000-gallon tanks would be located at the 800-foot portal and two 300,000-gallon tanks would be located adjacent to the generators.

Under Alternatives B and D, 5,000-gallon trucks would transport fuel from the laydown area to the mill site. Under Alternative C, an above-ground, 8,000-foot double-walled steel pipeline would be constructed to convey fuel from the fuel tanks near Comet Beach to the power plant and other facilities at the process area. The pipeline would parallel the access/haul road.

Under Alternative A, helicopter fuel would be stored at the heliport in a 10,000- to 15,000-gallon facility. Under Alternatives B through D, helicopter fuel would be stored in 5,000-gallon ISO containers at Comet Beach within the secondary containment area for the 300,000-gallon diesel tank.

2.3.10 Handling and Storage of Hazardous Materials and Chemicals

Under all alternatives, the chemicals and reagents required for the project would be handled and stored as detailed on page 2-26 of the FEIS. Alternatives B through D would not require sodium cyanide and chlorine handling or storage at the site because of offsite processing. Under Alternatives B through D, wastewater treatment would use sodium hydroxide or lime, a polymer additive, and possibly ferric chloride for chemical precipitation. In addition, polymer would be used to enhance filtration, and hydrogen sulfide would be used for pH adjustment. Under all alternatives, the operator would be required to operate under the requirements presented in the Hazardous Material Handling Plan and spill contingency programs in Chapter VII of the 1996 Revised Plan of Operations.

Under all alternatives, explosives and cap sensitive primers, including ammonium nitrate and fuel oil, used in underground mining would be stored at a central surface explosives magazine. The explosives magazine would be located at a site separate from the marine terminal facility and process area. Figures 2-1 through 2-4, presented previously, show the location of the explosives magazine for Alternatives A through D, respectively. The storage and use of the blasting materials would meet all pertinent Federal, State, and local regulations. The storage of explosives would specifically comply with applicable Bureau of Alcohol Tobacco and Firearms and MSHA regulations.

2.3.11 Non-Process Waste Disposal

Refuse

The Forest Service controls refuse disposal on National Forest lands. The disposal methods detailed in the FEIS meet current Forest Service and ADEC waste disposal policies. As approved in the Forest Service ROD, an incinerator would burn non-process refuse at the site. Under Alternative A, ashes from the incinerator would be disposed of in the tailings impoundment. Under Alternatives B through D, ashes from the incinerator would be disposed of

in privately owned areas of the mine according to ADEC solid waste permit requirements. Construction and demolition wastes would be salvaged as appropriate. Some construction and demolition wastes also would be managed in privately owned areas of the mine workings according to ADEC solid waste permit requirements.

Tailings from hardrock mines are subject to Alaska solid waste regulations. At its discretion, ADEC would incorporate applicable provisions of these regulations into the facility's solid waste disposal permit to address tailings management for the Kensington Gold Project.

Hazardous Waste

As discussed on page 2-27 of the FEIS, over the expected 12-year operating period, the project would be considered a small quantity generator (i.e., less than 2,200 pounds per month) of hazardous waste and would be regulated under the Resource Conservation and Recovery Act. All hazardous waste generated at the mine site would be stored temporarily onsite, in accordance with an approved hazardous material handling plan. The hazardous waste would be transported to a permitted hazardous waste treatment, storage, and disposal facility operating in accordance with all Federal, State, and local requirements.

Sanitary Wastewater

Under all alternatives, sanitary wastewater generated at the marine terminal complex would be collected and routed to a new onsite secondary sanitary wastewater treatment plant that would require a permit issued by EPA in consultation with ADEC. The treated effluent from this plant would be discharged to Lynn Canal through an existing sanitary wastewater pipeline. This pipeline would extend from the current sanitary plant to the discharge location, which is 300-feet offshore from the low-tide point. The sludge from the sanitary plant would be managed offsite. Under Alternative A, sanitary wastewater from the process area and camp facilities would go to the tailings impoundment. Under Alternatives B through D, sanitary wastewater from these areas would be collected and managed at an ADEC-permitted leach field at the process area.

2.3.12 Borrow Areas

Alternative A would include the development of several borrow areas (approximately 130 acres) to serve as a material source for both construction activities and long-term operational needs. All borrow areas would be located within the footprint of the tailings impoundment. Page 2-27 of the FEIS discusses these borrow areas. Alternatives B through D would involve the development of three sand and gravel borrow areas (16 acres) and a till borrow area (27 acres), which are shown in Figures 2-2 through 2-4, presented previously.

Under all alternatives, sand and gravel would be used for fill; facility foundations; plant, warehouse, and support facilities; and other construction needs. Under Alternatives B through D, approximately 1.5 million cubic yards (2.25 million tons) of till would be used for construction of the DTF. Coarse till would be used to provide a 2-foot-thick drainage layer along the outer surfaces of the DTF. Underlying glacial (fine) till would be needed to establish a hydraulic barrier between the DTF lifts and the DTF outer slopes. Based on soils studies performed by the

operator, the proposed site is the only readily accessible area of the site with sufficient material to meet till requirements under Alternatives B through D.

Discharges of runoff from all borrow areas would be regulated through an NPDES permit. Under all alternatives, the proposed borrow sites would be reclaimed concurrent with their development. Reclamation would involve grading, recontouring, and placement of growth media and seeding.

2.3.13 Reclamation and Closure

This section presents an overview of the reclamation process anticipated for activities associated with the Kensington Gold Project. Appendix B provides relevant sections of the reclamation plan submitted in support of the Proposed Action. Although the reclamation plan presents details specific to Alternative B, the processes and goals described would be similar for each alternative. Under all alternatives, the reclamation goals for the project are consistent with both the existing Land Use Designation II (LUD II) and the proposed change to the Modified Landscape (ML) designation.

Reclamation for the project site would focus on stabilizing disturbances and would ensure that all lands disturbed by exploration, construction, and operation of the mine and its related facilities would be returned to a suitable land use following mining activities. Reclamation activities would begin with stripping and stockpiling growth media prior to initial construction activities. Growth media piles would be seeded as part of an interim reclamation program, which would focus on reducing soil loss through erosion. Interim reclamation measures would include selective seeding, contouring, fertilizing, and mulching in accordance with Forest Service BMPs included in the *Soil and Water Conservation Handbook* (USFS, 1996b). Appendix C includes the applicable BMPs from the current handbook. These BMPs are subject to change over time. These measures would be employed in peripheral areas disturbed during exploration, construction, and operation and would minimize the amount of time during which land disturbances exist prior to temporary or permanent reclamation.

The initial stages of final reclamation would involve decommissioning facilities not necessary for the conduct of reclamation activities. This would include the removal or neutralization and proper disposal of chemicals and reagents, the removal of chemical and fuel storage tanks, and the salvage or demolition of buildings in the process area. Following the removal of facilities, the areas would be regraded to blend with the natural topography. Roads not required for long-term monitoring site access also would be reclaimed. Road closure activities would include removing or burying culverts, ripping the road surface, and contouring the cut and fill slopes to blend in with the surrounding terrain. The final contouring activities would restore normal surface drainage across the reclaimed roads. Stream crossings would be restored to their original conditions and bridges removed if they were determined not to be necessary for post-closure monitoring access.

Later stages of reclamation would include the removal of drainage controls as necessary from stabilized areas and the progressive removal, regrading, and revegetation of additional

facilities corresponding to the reduced demand for ongoing activities at the site. Final stages would include the removal of the structures and stabilization of the remaining disturbances.

Growth media would be applied over the regraded areas to a depth of one-half to one foot, followed by seeding. The selected seed mixtures would be applied to a prepared seedbed via broadcast seeding or other appropriate methods. The depth of growth media, plant species, and seed mixtures, as well as the use of fertilizer and amendments (e.g., lime and/or gypsum), would be directed by the outcome of the test plot programs conducted during the life of the operation. The use of mulch and other BMPs would minimize erosion until vegetation became established, and a monitoring program would be implemented to track the success of reclamation efforts.

Under Alternative A, closure would involve routing upper Sherman Creek and its unnamed tributary across the east end of the tailings impoundment into a pond adjacent to the Ophir Creek diversion. The pond would discharge to the Ophir Creek diversion, where the combined flows would fall through a spillway to lower Sherman Creek. All channels would be designed to carry the probable maximum flood.

Under Alternatives B through D, closure would include restoring the original channel of Ophir Creek. The diversion above the process area would be removed. The diversion channels around the DTF would remain in place and be redesigned to carry a 500-year, 24-hour storm event. The DTF would undergo concurrent reclamation as cells were developed. This would reduce the extent of disturbance in the project area over the life of the project. The process area and DTF settling ponds would be left as open water.

2.4 PROJECT COMPONENTS NOT STUDIED IN DETAIL

Pages 2-28 through 2-45 of the FEIS discuss project components that were eliminated from detailed study based on technical, environmental, legal, and regulatory criteria. Except for submarine tailings disposal (STD) and DTF design, analyses of project components not considered in detail in the FEIS remain applicable and are not repeated in this Draft SEIS.

2.4.1 Submarine Tailings Disposal

The FEIS discusses the potential for STD for the Kensington Gold Project. This component was eliminated from detailed consideration in the FEIS because the new source performance standards (40 CFR 440, Subpart J) for NPDES permits in this industry prohibit this disposal method. EPA recently proposed a change to these regulations to allow consideration of STD for the formerly proposed Alaska-Juneau (A-J) Mine Project. EPA proposed the regulatory change because the extreme topography and climactic conditions at the A-J Mine Project site appeared to make the use of a tailings impoundment impractical. EPA would not have finalized the proposed STD allowance if a feasible alternative to STD had been identified.

The circumstances associated with the Kensington Gold Project are different substantively from those of the A-J Mine Project. Although the A-J Mine Project might not have

had feasible alternatives to STD, all of the alternatives identified for the Kensington Gold Project appear feasible, including alternatives that incorporate the use of a DTF. The prohibition on STD, therefore, continues to apply to the Kensington Gold Project.

2.4.2 DTF Construction

During analysis for this Draft SEIS, two options for tailings management and construction of the DTF were identified but not considered in detail. Each option would increase stability of the DTF. The first option involves compacting all tailings. However, this option would be costly, and compaction might be difficult during high precipitation and/or freezing and thawing conditions. The second option would involve adding 3-percent cement to the tailings in a pug mill prior to transport and placement. This option also would be significantly more costly than DTF construction under Alternatives B through D. Primarily because these two options are more costly and would provide similar geotechnical stability as Alternative D, they were eliminated from detailed consideration.

2.5 MITIGATION AND MONITORING

The potential impacts associated with the alternatives depend in part on the mitigation and monitoring programs proposed for the project.

2.5.1 Mitigation

Mitigation measures would lessen or eliminate impacts associated with the different alternatives. In general, many mitigation measures for the Kensington Gold Project have already been incorporated into the 1996 Revised Plan of Operations. The following paragraphs describe additional mitigation measures required for the alternatives by resource. Chapter 4 of this Draft SEIS considers these mitigation measures during assessment of the potential impacts.

Air Quality

Within 6 months of the ROD, the operator would be required to develop an energy efficiency plan to minimize carbon dioxide emissions to the atmosphere.

Water Resources

Additional treatment of DTF effluent beyond enhanced settling is a contingency under Alternatives B through D. The same wastewater treatment options would be available for the DTF effluent as described for mine drainage (see pages 2-12 through 2-15 of the FEIS). These include precipitation and filtration for metals and solids. The nature of influent to the DTF pond, the existing tailings characterization data, and projected effluent composition (see Section 4.4 of the Draft SEIS) currently suggest that no additional treatment would be needed to meet NPDES permit limits. If actual monitoring data indicated higher than anticipated metals in the DTF pond effluent, EPA could require the operator to provide treatment to ensure compliance with NPDES permit limits.

In developing the final design for the road under Alternatives B through D, the operator would investigate the feasibility of eliminating the downstream crossing of upper Sherman Creek immediately north of the sand and gravel borrow area. The operator would also evaluate the potential for reducing the extent of the upstream Sherman Creek conduit. One option to be considered would include potential modifications to the mill area layout to minimize fill encroachment on the stream channel. The feasibility of such changes cannot be determined until finalization of the road location and design after the ROD.

In addition, the Forest Service requires BMPs for nonpoint source and construction-related discharges to surface water resources. The purpose of BMPs is to protect water quality and abate or mitigate water quality impacts. There are three types of BMPs: administrative, preventive, and corrective. Administrative BMPs are implemented as organizational controls (e.g., scheduling construction to avoid the highest precipitation periods). Preventive BMPs are used to minimize the effects of an activity on water quality (e.g,. spreading grass seed on exposed soil). Corrective BMPs are applied in the field to address a problem (e.g., installing riprap to prevent streambank erosion).

The *Soil and Water Conservation Handbook* presents Forest Service BMP requirements (USFS, 1996b). Appendix C provides the relevant sections of the handbook and the applicability of the BMPs to hardrock mining operations. The handbook requirements and anticipated NPDES permit requirements for point source discharges formed the basis for the BMPs included in the 1996 Revised Plan of Operations. The Forest Service is responsible for ensuring adherence to the Plan of Operations, including identified BMPs. The Forest Service also would require the following additional BMPs as mitigation measures (see Appendix C):

- Avoid construction activities in Sherman Creek and its tributaries during critical life stages of anadromous fish (BMP 14.6). In general, this would range from adult entry into lower Sherman Creek until fry left the watershed. The Forest Service and the Alaska Department of Fish and Game would determine the specific timing.

- Include in the final Plan of Operations an erosion control plan for construction and maintenance of roads and borrow areas. The plan specifically addresses BMPs 14.9, 14.15, 14.17, 14.18, and 14.20.

- Incorporate oil-water separation into the process area runoff management system.

- Include in the spill prevention control and countermeasures plan specific provisions for cleanup of a worst-case diesel fuel spill along the road (Alternatives A, B, and D), pipeline (Alternative C), and fuel transfer and storage areas (all alternatives).

Under the NPDES permit for any alternative, EPA could require additional BMPs for point source discharges. For combined process and storm water point source discharges, BMPs would be required, as necessary, to meet effluent limitations for sediment and toxic pollutant loadings to surface water. For storm water only point source discharges, BMPs would be developed and implemented as part of the facility's storm water pollution prevention plan required by the NPDES permit.

Soils, Vegetation, and Wetlands

The following mitigation measures would be implemented under any alternative selected to address sensitive species:

- Prohibit the collection of plants or plant parts except by permit issued by the Forest Supervisor for scientific or educational purposes.
- Use plants native to the area and originating near the project area for reclamation to the extent possible, and prohibit the use of herbicides within 100 feet of any known sensitive plant.
- Close the area to off-road vehicle use.
- Maintain drainage patterns, water quality, and water quantity to the extent possible to support aquatic plant populations and habitats.

Visual Resources

The following mitigation measures would be implemented under any alternative selected to address visual resources:

- Locate roads to minimize visual impacts from the Alaska Marine Highway and tour ship travel routes in Lynn Canal.
- Use full bench cuts and end-hauled material when slopes are too steep to hold material and/or where residual trees do not provide enough screen to permit the road to meet visual quality objectives.
- Minimize right-of-way clearing as cut and fill slopes permit.
- Mitigate the effects of sidecast slash within 30 feet of road shoulders by the most appropriate method: 1) endhaul slash to a central approved area or 2) pile slash in non-impacting areas. Slash should be consolidated as much as practical, covered with soil, and shaped into a natural contour.
- Apply seed and fertilizer (as necessary) to all disturbed areas to be reclaimed, including cut/fill embankments and roadways. Typical seed mixtures should reflect vegetation and growth characteristics of Southeast Alaska. Appropriate herbaceous materials, for example, would include Alyeska Polargrass (*Arctagrostics latifolia*), Actared Red Fescue (*Festuca rubra*), Norcoast Bering Hairgrass (*Dechampsia beringensis*), and Gruening Alpine Bluegrass (*Poa alpina*).
- Locate and design borrow pits to minimize visual impacts and retain screen trees where necessary to meet the visual quality objective.
- Use earth-tone colors on all building exteriors to blend with the surrounding natural landscape.

- Design structures to repeat forms, lines, and textures that occur frequently in the surrounding landscape.
- Direct exterior lighting inward wherever possible.

2.5.2 Monitoring

The purpose of monitoring is to collect data of known quality to verify projected impacts, evaluate the effectiveness of mitigation measures, and determine the effectiveness of reclamation efforts. Regulatory agencies and the operator would review the results of all monitoring activities. If environmental changes varied substantially from those predicted, the regulatory agencies would determine what actions, if any, the operator would need to implement to reduce or eliminate project-related effects. Table 2-2 lists monitoring activities identified for selected resources.

Water Quality

Individual permits for the project would include more detailed monitoring requirements for specific resources. A detailed monitoring plan would be developed by the operator in cooperation with the Forest Service specifically for surface water quality as part of the final Plan of Operations. This monitoring plan would combine the following elements:

- Purpose, information goals, and monitoring objectives
- Network design
  - Station location
  - Constituent selection
  - Sampling frequency
  - Sample collection, handling, and shipping procedures
- Field sampling
  - Training
  - Protocols
  - Field quality control
  - Constituents
- Laboratory procedures
  - Analysis techniques
  - Quality control and assurance procedures
  - Data recording standards
  - Required lab quality control sample and frequency

Table 2-2. Summary of Monitoring Activities for Selected Resource Objectives

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Construction, Operation, and Reclamation Specifications						
Construction, operation, and reclamation according to Plan of Operations and permit requirements.	Documentation, reporting, and inspections	Ongoing	Non-conformance with approved design specifications	To be determined by individual agencies	ROD, final Plan of Operations, NPDES permit, Section 404 permit	Forest Service/EPA/Corps of Engineers
Water Quality/Hydrology						
Effluent treatment measures	Inspect implementation of design and mitigation measures outlined in Final Plan of Operations, SEIS, and SPCC Plan	Ongoing	Operability of measures at all times	Cannot discharge effluent to receiving waters until measures implemented	ROD, SPCC, NPDES permit	Coeur Alaska with Forest Service, ADEC, and EPA review
Implementation of best management practices (BMPs) to control pollution from sediment, petroleum products, and hazardous or toxic wastes (including metals) during construction and operation	Review site-specific BMP plans and inspect implementation of plans	During construction - ongoing During operation - monthly	Evidence that BMPs are not designed and implemented correctly	Require additional or improved pollution control measures	ROD, final Plan of Operations, NPDES permit	Forest Service, ADEC, EPA, and Coeur Alaska
Effluent compliance with NPDES permit	Implement methods according to NPDES permit	Frequency indicated in NPDES permit	Thresholds at NPDES permit limits	Notify as required by NPDES permit and final Plan of Operations; implement additional measures to correct the noncompliance	NPDES permit	Coeur Alaska with EPA review
Surface water quality	Implement methods according to NPDES permit	Frequency indicated in NPDES permit	Trend showing effects on water quality	Per NPDES permit	NPDES permit	Coeur Alaska with EPA review
Effectiveness of BMPs in controlling nonpoint source pollution during construction and operation	Collect and evaluate data on relevant water quality constituents from sites located above and below mine activity	During construction and operation - varies from weekly to quarterly depending on the site and the year after construction or agency	Evidence that nonpoint source pollution control measures are not installed correctly, maintained operationally, or effective; compliance with water quality criteria or change in water quality trends	Require additional or improved pollution control measures	ROD, final Plan of Operations	Coeur Alaska with Forest Service review

Table 2-2. Summary of Monitoring Activities for Selected Resource Objectives (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Effectiveness of impoundment and seepage control structures in maintaining or improving the water quality in fish-bearing streams below impoundment (Alternative A only)	Sample ground water, seepage pond, and stream below impoundment for standard aquatic water quality parameters and biomonitoring	Monthly to quarterly	Flow quantities exceeding the amounts predicted in the SEIS; quality exceeds background levels in streams.	Take action to intercept seepage around or under tailings pond	ROD, final Plan of Operations, NPDES permit	Coeur Alaska with Forest Service and EPA review
Ground water quality effects of DTF (Alternatives B-D)	Sample ground water upgradient and downgradient of DTF	According to solid waste permit	Per solid waste permit	Per solid waste permit	Solid waste permit	Coeur Alaska with ADEC review
Maintenance of minimum flows in Sherman Creek	Monitor stream flows below diversion (Alternative A) and below intake (Alternatives B-D)	As established by Alaska Department of Natural Resources (ADNR) instream flow permit	Instream flow levels set by ADNR permit	Limit water withdrawal to levels established by ADNR permit	ROD, ADNR, water rights permit	Coeur Alaska with Forest Service and ADNR review
Compliance with storm water regulations	Sample and inspect according to NPDES permit	According to NPDES permit	Per NPDES permit	Per NPDES permit	NPDES permit	Coeur Alaska with EPA and ADEC review
Effectiveness of reclamation measures in maintaining water quality at the mine site	Monitor above and below the impoundment (Alternative A) and mill and DTF sites (Alternatives B-D)	Vary with time after reclamation	Background levels	Implement additional reclamation efforts	ROD, final Plan of Operations	Coeur Alaska with Forest Service review
Effectiveness of reclamation in maintaining stable, self maintaining stream channels	Monitor reclaimed channels for stability	Vary with time after reclamation	Self maintaining, productive channels	Implement additional reclamation efforts	ROD, final Plan of Operations	Coeur Alaska with Forest Service review
Aquatic Resources						
Discharge effect on aquatic organisms	Perform bioassays of discharges to surface water, fish surveys above and below discharges	Per NPDES permit	Per NPDES permit	Per NPDES permit	NPDES permit	Coeur Alaska with ADEC and EPA review
Spawning salmon escapement survey	Conduct spawner counts using established procedures	Yearly	When results of this monitoring, in addition to other information, indicate habitat capabilities are changing as a result of mine activities	Meet with EPA, ADEC, and Forest Service to discuss potential problem; could result in change in construction or operating practices and mitigation in nearby streams	Final Plan of Operations	Coeur Alaska with ADEC and Forest Service
Benthic macroinvertebrate community composition	Sample from known sites using established procedures	Yearly	Trend showing effects on benthic community composition	To be determined in NPDES permit	NPDES permit	Coeur Alaska with EPA and ADEC review

Table 2-2. Summary of Monitoring Activities for Selected Resource Objectives (continued)

Resource/Item to Measure	Method of Measurement	Frequency of Measurement	Threshold of Variability	Action To Be Taken	Authority	Responsible Party
Spawning gravel composition and embryo survival	Sample using established procedures	Yearly	Trend showing effects on gravel composition and embryo survival	To be determined in NPDES permit	NPDES permit	Coeur Alaska with EPA and ADEC review
Water temperature.	Sample using established procedures	Yearly	Trend showing effects on water temperature	To be determined in NPDES permit	NPDES permit	Coeur Alaska with EPA and ADEC review
Sediment quality (metals toxicity and other characteristics)	Sample using established procedures	Annual	Trend showing increased toxicity and/or metals levels	To be determined in NPDES permit	NPDES permit	Coeur Alaska with EPA and ADEC review
Aquatic habitat characteristics	Sample using established procedures	Yearly	Trend showing reduction in spawning gravels	Meet with EPA, ADEC, Alaska Department of Fish and Game (ADF&G), and Forest Service to discuss potential problem; could result in change in construction or operation practices and mitigation in nearby streams	Final Plan of Operations	Coeur Alaska with ADF&G and Forest Service review
Wildlife						
Eagle nest management	Visit nest sites	Years 1 and 2 of project development, every month May - August; after second year, annually	A change (an occupied nest is no longer occupied) due to mining-related activity	Consult with U.S. Fish and Wildlife Service, Forest Service, and Coeur Alaska to modify activity if deemed to be influencing the observed change (nest abandonment)	Eagle Protection Act, final Plan of Operations	Forest Service and U.S. Fish and Wildlife Service
Stellar sea lions, marine mammals (seals)	Observe known haulout sites	Annually while activities are occurring; during times when haulouts occupied	Evidence of harassment of marine mammals as direct result of mining-related activities	Enforce Marine Mammal Protection Act	Marine Mammal Protection Act, Endangered Species Act	National Marine Fisheries Service
Mountain goat monitoring	Conduct population surveys, track radio-collared goats	Several flights per year	Evidence of extreme adverse reaction to mining-related activities causing abandonment of habitat	Consult to minimize disturbance; if disturbance cannot be minimized causing loss of mountain goat population, mitigation could involve reintroduction	Agreement with Coeur Alaska	ADF&G and Forest Service
Vegetation						
Compliance with timber sale contract provisions (sale administration)	Conduct onsite inspections	Before, during, and after harvest activities	In compliance with contract clauses or not	Get back into compliance	36 CFR Part 223	Forest Service

Table 2-2. Summary of Monitoring Activities for Selected Resource Objectives (continued)

Visual Quality						
Operations monitoring: compliance with visual quality objective	Conduct field observation and document with photos taken from established viewpoints	After construction, during operations, and after project completion	Determine if visual impacts exceed anticipated impacts	Recommend additional mitigation	FSH 2309.22	Forest Service
Reclamation monitoring: compliance with visual quality objective	Conduct field observation and document with photos taken from established viewpoints	Once every 5 years for 15 years after reclamation	Determine if visual impacts exceed anticipated impacts	Photos would be used as reference in determining impacts and achieving VQOs in future planning	FSH 2309.22	Forest Service
Geotechnical Stability						
Tailings structure: construction materials	Conduct visual inspection and gradation testing	As dictated by selected design needs	Per design documents	Remove non-conforming material	Forest Service, final Plan of Operations	Coeur Alaska and Forest Service
Tailings structure: construction methods	Perform compaction and moisture tests along with other standard engineering practices	As dictated by selected design needs	Per design documents	Remove non-conforming material or apply additional effort to installation	Forest Service, final Plan of Operations	Coeur Alaska and Forest Service
Tailings structure: ongoing performance	Perform visual inspection, water table measurements; determine pore pressure; measure vertical and horizontal movement	At minimum quarterly, more frequent as dictated by selected design; after large earthquakes or other natural events	Per design documents	Per analysis of variance	Forest Service, final Plan of Operations	Coeur Alaska with Forest Service review
Waste rock pile stability	Perform visual inspection	Annually	Visible movement	As dictated by findings	Final Plan of Operations	Coeur Alaska with Forest Service review

- Data handling
  - Data screening and verification
  - Data base maintenance
  - Data reporting and distribution
  - Filing procedures and security
- Data analysis needs
  - Graphical and/or statistical requirements
  - Compliance with State criteria
  - Trend analysis
  - Quality control interpretation
  - BMP effectiveness
- Monitoring evaluation
  - Establishment of evaluation criteria (State water quality standards, NPDES requirements) that would invoke implementation of additional mitigation measures
  - Annual review of program for update and/or modification of program and plan.

Data from monitoring that was initiated as a result of the 1992 FEIS led the Forest Service and Alaska Department of Fish and Game (ADF&G) to reevaluate parts of the wildlife monitoring plan described in the FEIS. The remainder of this section discusses the reevaluation.

Black Bears

Results from radio telemetry work indicate that the project area has a high density of black bears and that denning occurs within the project area. Additional telemetry work, as described in the monitoring section of the FEIS, would not yield more useful information. Rather than continuing telemetry work through the construction phase and into the operation phase of the mine, it would be better to concentrate on mitigating the potential problems that could occur as a result of the mine development. The operator would work closely with the Forest Service and ADF&G in the final design and implementation stages of the mine development to reduce impacts to the area's black bear population. Special attention would be focused on plans for food handling and garbage disposal. Wet garbage would be specifically collected on a daily basis from each area of the site and taken to the well-fenced incinerator.

Mountain Goats

The original monitoring goals for construction and operation of the mine were to determine if the activities associated with mine development would result in disturbance or displacement of the mountain goats that use the habitat adjacent to the mine. The level of monitoring identified in the FEIS would not likely provide enough information to determine

cause-and-effect relationships between mountain goat movement patterns and mineral development.

Results from the pre-construction monitoring have shown that a more intensive effort would be required to determine the cause and effect relationships in the original monitoring goal. A monitoring effort of this magnitude would require more mountain goats to be radio-collared and more crews stationed in the field gathering data. These activities would have their own impact on the mountain goat population. There would also be increased costs for a study of this nature. The Forest Service and ADF&G reevaluated the costs and effects of the proposed monitoring in the FEIS and developed an alternative monitoring goal. The revised monitoring plan will have less effects on the mountain goats, provide sufficient information to allow the operator to respond to a need to change activities that are displacing the herd, and be more cost-effective. For these reasons, the Forest Service and ADF&G monitoring goal will be to obtain yearly population estimates, gather herd composition information, and determine areas of high use. This goal will enable the Forest Service and ADF&G to determine population trends over the life of the mine. The goal can be reached by maintaining up to 20 radio-collared animals in the area and conducting survey flights several times each year. ADF&G is working with the operator on a cooperative agreement to conduct this monitoring.

Body Tissue Monitoring

In the monitoring plan identified in the FEIS, mink were to be collected from the Sherman Creek drainage in order to determine the levels of various metals in tissues. This would indicate whether metals could be bioaccumulating in animals that use the habitats that are potentially impacted by the project. Because the data collected to date are highly variable, many more samples would be required to determine any trends or cause-and-effect relationships between levels of metals in tissue samples and mine development. Removing more animals from the drainage on a yearly basis would likely result in a temporary depletion of the mink population. New mink would quickly move into the area; however, tissue samples taken from their bodies could add a bias to the data because they would not have spent much time in the impacted area. Because of these potential problems, mammal tissue sampling has been eliminated from the monitoring plan.

2.5.3 Implementation of Mitigation and Monitoring

If the No Action Alternative (Alternative A) is selected, mitigation and monitoring would be implemented as specified by the FEIS and the 1992 Approved Plan of Operations. If one of the action alternatives—B, C, or D—is selected, mitigation and monitoring would be implemented as specified in the FEIS and Draft SEIS, the 1996 Revised Plan of Operations, and the permits summarized in Section 1.6 of the Draft SEIS. These permits probably would contain specific management, mitigation, and monitoring requirements for the project. The agencies issuing the permits then would be responsible for enforcing these measures. Elements of different agencies' monitoring plans for the same resources could vary depending on individual agency goals and requirements.

2.6 IDENTIFICATION OF THE PREFERRED ALTERNATIVE

The Forest Service, EPA, and Corps of Engineers have identified Alternative D as the preferred alternative.

2.7 COMPARISON OF ALTERNATIVES

The alternatives for the Kensington Gold Project were developed and evaluated by project component based on the issues identified as part of the public scoping process. Table 2-3 summarizes and compares the alternatives according to the project components discussed in Section 2.3. The Forest Service, EPA, and Corps of Engineers reviewed all of the issues for significance. Significant issues were used to compare the potential effects of all project alternatives. Table 2-4 summarizes the potential impacts of each alternative according to the significant issues. Table 2-5 summarizes the potential impacts of each alternative by resource.

Table 2-3. Comparison of Alternatives by Project Component

Project Component	Alternative A	Alternative B	Alternative C	Alternative D
Project Location	Sherman Creek Drainage Basin	Sherman Creek Drainage Basin; Terrace Area Drainage Basin	Same as Alternative B	Same as Alternative B
Mining Methods	Long-hole, open stoping	Same as Alternative A	Same as Alternative A	Same as Alternative A
Waste Rock Disposal	About 50 percent consumed in roads and tailings dam, 50 percent remains in 15-acre permanent stockpile at mine entrance	Used in DTF construction and some backfill, 15-acre temporary pile at mill	Same as Alternative B	Same as Alternative B
Ore Processing	Onsite flotation and cyanidation	Onsite flotation, concentrate transported offsite by barge for further processing	Same as Alternative B	Same as Alternative B
Water Management	Alkaline chlorination for cyanide destruction; enhanced pond settling, discharge to Lynn Canal ¼ to ½ mile offshore north of Point Sherman Effluent pipeline 2.7 miles Ophir and Sherman creeks diverted, total habitat loss - 6,000 ft	Fresh water discharges to Sherman Creek (outfall 001) and Unnamed Creek (outfall 002); enhanced settling in ponds, precipitation/ filtration of mine drainage No effluent pipeline Ophir Creek diverted, total habitat loss - 2,450 ft	Marine discharge of mine drainage and DTF effluent 300 feet offshore north of Point Sherman, process area runoff to upper Sherman Creek, enhanced settling in ponds, application for mixing zone. Effluent pipeline 2.2 miles Ophir Creek diverted, total habitat loss - 2,450 ft	Same as Alternative B
Tailings Disposal	Cross valley dam in Sherman Creek Negligible tailings pipeline	Dry disposal at Site B in 220 ft high unit, constructed with engineered drainage system, backfill 25 percent of tailings No tailings pipeline	Same as Alternative B	Dry disposal at Site B in 220 ft high unit, engineered structural berm around perimeter, backfill 25 percent of tailings 8,000-ft tailings pipeline
Employee Housing and Transportation	Onsite camp at mill site; employees transported by helicopter to site	Onsite camp at mill site, north of the FEIS site; employees transported by helicopter to site	Same as Alternative B	Same as Alternative B
Power Supply	Two LPG-fired generators at beach	Four diesel generators at the mill and one generator at Comet Beach; diesel trucked to mill	Four diesel generators at the mill and one generator at Comet Beach; diesel piped to mill	Four diesel generators at the mill and one generator each at Comet Beach and the DTF; diesel trucked to mill

Table 2-3. Comparison of Alternatives by Project Component (continued)

Project Component	Alternative A	Alternative B	Alternative C	Alternative D
Fuel Use and Storage	LPG stored in 300,000-gallon tank near Comet Beach, piped to 20,000-gallon tank at process area; diesel fuel stored in 150,000-gallon tank near Comet Beach and 20,000-gallon tank near process area Diesel trucked from Comet Beach to process area	Diesel fuel stored in 1) 300,000-gallon tank near Comet Beach, 2) 300,000-gallon tank near laydown area, and 3) two 300,000-gallon and two 20,000-gallon tanks near process area Fuel trucked from laydown area to process area	Same as Alternative B except fuel piped 8,000 ft from laydown area to process area	Same as Alternative B
Handling, Storage, and Disposal of Hazardous Materials and Chemicals	Storage of reagents and solvents consistent with hazardous material handling plan and disposal under small quantity generator permit; sodium cyanide shipped to site in ISO containers	Storage of reagents and solvents consistent with hazardous material handling plan and disposal under small quantity generator permit; no sodium cyanide	Same as Alternative B	Same as Alternative B
Non-Process Waste Disposal	Combustibles incinerated; ash to impoundment; any noncombustibles generally shipped to Juneau for disposal in approved facility; some construction waste to mine	Same as Alternative A, except ash to mine	Same as Alternative B	Same as Alternative B
Borrow Areas	Sand gravel areas within impoundment drainage (total 130 acres)	Three sand and gravel quarries near the process area (total 16 acres); till borrow area (27 acres) northwest of the rock quarry	Same as Alternative B	Same as Alternative B
Reclamation and Closure	All structures removed except impoundment, surfaces regraded and revegetated, Sherman Creek routed to pond at east end of impoundment	All structures removed except diversions upgradient of DTF and settling ponds, settling ponds retained as wetlands, surfaces regraded and revegetated, Ophir Creek restored to natural drainage	Same as Alternative B	Same as Alternative B
Total Disturbance	282 acres	250 acres	253 acres	270 acres

Table 2-4. Summary of Potential Impacts of Each Alternative by Significant Issues

Alternative	Summary of Potential Impact
Water Quality (from discharges)	
Alternative A - No Action	Marine - Levels of cyanide, metals, and total suspended solids in effluent discharge could meet water quality standards with a mixing zone. No impacts to fisheries expected. Sediment accumulation is expected in the vicinity of the outfall. Some heavy metal accumulation could occur only in sedentary, bottom-dwelling organisms (e.g., tubified worms and polychaetes) near the outfall. Fresh water - Construction of the tailings impoundment and diversions initially would increase sediment loads along a 1,000-foot downstream portion of pink salmon spawning habitat in Sherman Creek. Sediment loadings at closure would depend on reclamation success and geotechnical impacts.
Alternative B - Proposed Action	Marine - No direct marine discharge. Fresh water discharges ultimately would reach Lynn Canal, but compliance with all standards would minimize any marine impacts. Fresh water - Discharges would comply with all technology- and water quality-based permit limits without a mixing zone. Construction of the DTF and other facilities and runoff during active operations could increase sediment loads to Sherman Creek and the unnamed creeks in the Terrace Area.
Alternative C - Marine Discharge	Marine - Levels of metals and total suspended solids in effluent discharge would meet water quality standards with mixing zone. No impacts to fisheries expected. Sediment accumulation expected in the vicinity of the outfall. Some heavy metal accumulation could occur only in sedentary, bottom-dwelling organisms (e.g., tubified worms and polychaetes) near the outfall. Fresh water - Similar to Alternative B, except no discharge of mine drainage or DTF effluent to fresh water.
Alternative D - Modified DTF Design	Same as Alternative B.
Air Quality (increased emissions, including CO_2)	
Alternative A - No Action	Air quality impacts would be well below allowable Federal and Alaska ambient air quality standards.
Alternative B - Proposed Action	Air emissions of NO_X, SO_X, CO, and total suspended particulates would be greater than Alternative A but still below air quality standards. CO_2 emissions slightly higher than Alternative A.
Alternative C - Marine Discharge	Same as Alternative B.
Alternative D - Modified DTF Design	Similar to Alternative B, except that vehicle emissions would be slightly reduced, along with less fugitive dust from the road.
Geotechnical Considerations (potential failure of tailings unit)	
Alternative A - No Action	Tailings dam would be constructed using a modified centerline technique and would be designed to withstand maximum probable storm event and seismic event for the region. Ongoing monitoring during operation. Avalanche control features.
Alternative B - Proposed Action	DTF would be designed to maintain unsaturated tailings through engineered drainage system and temporary and permanent barriers. Design would account for maximum credible seismic event. Intensive ongoing monitoring during operations; pre-designed contingencies, including berm, depend on monitoring results.
Alternative C - Marine Discharge	Same as Alternative B.
Alternative D - Modified DTF Design	Modified DTF design would include engineered structural berm.
Spill Potential From Increased Use of Diesel Fuel	
Alternative A - No Action	Limited use of diesel fuel.
Alternative B - Proposed Action	Increased risk of spill due to increased diesel usage primarily for power generation. Diesel would be transported, handled, and stored according to SPCC plan and State spill response requirements. Diesel transport from Comet Beach to mill by truck.
Alternative C - Marine Discharge	Similar to Alternative B, except double-walled pipe used to transport diesel from laydown area to mill.
Alternative D - Modified DTF Design	Similar to Alternative B, but slightly reduced diesel usage due to less road traffic.
Visual Impacts	
Alternative A - No Action	Primary visual impact would involve Sherman Creek tailings dam (270 ft high x 2,400 ft long).
Alternative B - Proposed Action	At full construction, DTF (220 ft high x 5,000 ft long) would average about 150 feet above treeline. Downslope would be reclaimed upon completion, and individual cells would be reclaimed fully immediately after completion. Borrow pits, roads, and facilities hidden by the tailings impoundment under Alternative A would be visible to marine traffic. Increased road width and traffic compared to Alternative A. Dust control and concurrent reclamation would be used to minimize emissions.
Alternative C - Marine Discharge	Same as Alternative B.
Alternative D - Modified DTF Design	Same as Alternative B, except road traffic would be decreased by use of a tailings pipeline.

Table 2-5. Summary of Potential Impacts of Each Alternative by Resource*

Resource	Impact	Alternative A	Alternative B	Alternative C	Alternative D
Air Quality and Climate	Air Quality	Predicted pollutant emissions less than State and Federal standards.	Predicted emissions higher than Alternative A but less than State and Federal standards.	Same as Alternative B.	Same as Alternative B.
Topography	See FEIS.	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Geology	See FEIS.	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Geotechnical Considerations	Probability of Tailings Facility Failure	Negligible.	Low to moderate.	Same as Alternative B.	Very Low.
Surface Water Hydrology	Water Withdrawals	190 gpm (0.42 cfs), impoundment of upper Sherman Creek.	234 gpm (0.52 cfs), infiltration gallery on upper Sherman Creek	Same as Alternative B.	Same as Alternative B.
	Stream Diversions	2 diversions, totaling 2.1 miles.	4 diversions, totaling 2.3 miles. Potential impact to Ivanhoe Creek because of increased flows from Ophir Creek Diversion.	Same as Alternative B.	Same as Alternative B.
	Stream Flow	Potential impact to instream flows during winter low-flow periods. Marine discharge of mine drainage would reduce average stream flow 0.8 cfs in Sherman Creek.	Potential impact to instream flows during winter low-flow periods in Sherman Creek between withdrawal and discharge point. Discharge of mine drainage to Sherman Creek, increasing average stream flow 1.3 cfs.	Similar to Alternative A, except process area runoff discharged to Sherman Creek.	Same as Alternative B.
Surface Water Quality	Sedimentation	Highest potential for sediment loading to Sherman Creek would be during construction (282 acres of disturbance). Sediment controlled through settling in impoundment and BMPs.	Highest potential for sediment loading to Sherman Creek would be during construction (250 acres of disturbance). Sediment controlled through sediment ponds and BMPs.	Highest potential for sediment loading to Sherman Creek would be during construction (253 acres of disturbance, including disturbance of 2.7 acres due to pipelines). Sediment controlled through sediment ponds and BMPs.	Highest potential for sediment loading to Sherman Creek would be during construction (270 acres of disturbance, including disturbance of 1.8 acres due to tailings slurry and reclaim pipelines) and up to 18 acres for DTF berm. Sediment controlled through sediment ponds and BMPs.
	Effluent Quality	No process water discharge to fresh water; see Aquatic Resources, Marine.	No impacts; effluent would comply with water quality-based NPDES permit limits at discharge point. Negligible onsite acid generation potential.	No process water discharge to fresh water, except process area runoff. Discharge of process area runoff would meet water quality-based permit limits at discharge point.	Same as Alternative B.
	Spills	Seepage from or failure of the tailings dam, or leakage or rupture of the effluent pipeline, could discharge effluent into Sherman Creek (maximum pipeline volume 17,000 gallons).	Potential for accidental release during transportation of 5 tons of lead nitrate, 5,000 gallons of diesel fuel, or 50 tons of tailings into Sherman Creek.	Potential for accidental release during transportation of 5 tons of lead nitrate or 50 tons of tailings into Sherman Creek. Rupture of the diesel pipeline could release 17,000 gallons of fuel into Sherman Creek. Rupture of the effluent pipeline could release 17,000 gallons of mine drainage and DTF effluent into Sherman Creek.	Potential for rupture of tailings pipeline could result in the release of up to 270,000 gallons of tailings to Sherman Creek. Potential for accidental release during transportation of 5 tons of lead nitrate or 5,000 gallons of diesel fuel.

*Chapter 4 presents a detailed discussion of potential impacts.

Table 2-5. Summary of Potential Impacts of Each Alternative by Resource (continued)*

Resource	Impact	Alternative A	Alternative B	Alternative C	Alternative D
Ground Water Hydrology	Ground Water Flow	Underground mine drainage would create a localized cone of depression. Minimal impacts on overall sitewide hydrology and hydrogeology.	Similar to Alternative A. DTF would have limited effects in Terrace Area.	Same as Alternative B.	Same as Alternative B.
	Ground Water Quality	No effects from mine workings. Seepage from tailings impoundment collected and returned to impoundment; monitored to determine any need for mitigation after closure.	No effects from mine workings. Infiltration through waste rock and DTF consistent with background surface and ground water quality. Negligible acid generation potential.	Same as Alternative B.	Same as Alternative B.
Aquatic Resources, Marine	Water Quality	Mixing zone required for cyanide, lead, copper, and mercury. Cyanide requires largest dilution (31:1) to meet water quality-based permit limits. Discharge location moved to ½ mile offshore away from nearshore eddies and commercial fishing area. 1 in 3 risk of diesel fuel spill from transfer (maximum 880 gallons). Low spill risk from LPG, cyanide, and chlorine transport.	No impacts from effluent discharges. Probability of 1 to 2 diesel fuel spills from transfer. No use of LPG, cyanide, or chlorine.	5:1 mixing zone required for copper only. Discharge 300 feet offshore. Same as Alternative B for spills.	Same as Alternative B.
	Sedimentation	Negligible.	Negligible.	Negligible.	Negligible.
	Habitat Loss	Negligible.	Negligible.	Negligible.	Negligible.
Aquatic Resources, Fresh Water	Habitat Loss through Diversions (linear feet)	6,000	2,450	Same as Alternative B.	Same as Alternative B.
	Fish Mortality	400-500	125-170	Same as Alternative B.	Same as Alternative B.
	Water Withdrawal (cfs)	0.42	0.52	Same as Alternative B.	Same as Alternative B.
Soils	See FEIS.	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Vegetation	Total Vegetation Disturbance (acres)	282	250	253	270
	Timber Removed (mmbf)	3.3	2.7	Same as Alternative B.	Same as Alternative B.
	Acres of Old Growth Forest Removed	86.5	71.6	72.7	73.2
Wetlands	Acres of Wetland Loss (short term)	271	243	246	262
	Acres of Wetland Loss (long term)	51	147	Same as Alternative B.	164
	Type of Wetland Loss (majority)	Palustrine forested.	Palustrine scrub-shrub.	Same as Alternative B.	Same as Alternative B.

*Chapter 4 presents a detailed discussion of potential impacts.

Table 2-5. Summary of Potential Impacts of Each Alternative by Resource (continued)*

Resource	Impact	Alternative A	Alternative B	Alternative C	Alternative D
Wetlands (continued)	Permanent Loss of Functions and Values	Temporary or permanent loss of surface hydrologic control (moderate to high values), sediment retention (low to high values), wildlife diversity (moderate values), and riparian support (moderate to high values).	Temporary or permanent loss of surface hydrologic control (moderate to high values), sediment retention (low to high values), and riparian support (moderate to high values).	Same as Alternative B.	Same as Alternative B.
Socioeconomic Resources	Direct Employment and Payroll Effects	Increase of 289 and 286 workers during first and second years of operation, respectively, and average of 344 during operations.	Increase of 164 and 338 workers during first and second years of construction, respectively, and average of 253 during operations.	Same as Alternative B.	Same as Alternative B.
	Housing Effects	Total housing requirement would increase to between 96 and 143 units during first 2 years of construction and between 217 to 292 units during operations.	Total housing requirement would increase to between 36 and 126 units during first 2 years of construction and 217 units during operations.	Same as Alternative B.	Same as Alternative B.
	Effects on CBJ Revenues and Expenditures	Increase in property tax revenues. Increase in sales tax revenues. Increase in revenues from State sources. Possible increase in work load and related costs for CBJ.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
	Employment and Payroll Effects (City of Haines, Borough of Haines, and City of Skagway)	Negligible.	$2.58 million in additional annual earnings by Haines residents. Negligible increase in total employment for Skagway residents.	Same as Alternative B.	Same as Alternative B.
	Population Related Effects (City of Haines, Borough of Haines, and City of Skagway)	Negligible.	Slight increase in present Haines population, but minor compared to seasonal population growth. Only a minor increase in Skagway population due to high unemployment.	Same as Alternative B.	Same as Alternative B.
Wildlife	See FEIS.	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Recreation	See FEIS.	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Cultural Resources	See FEIS.	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Visual Resources	Disturbance	Primarily tailings impoundment. See FEIS.	Borrow pits, DTF, roads, and structures. Probably would not meet VQO during operations. Would likely meet VQO after reclamation .	Same as Alternative B.	Same as Alternative B.
Subsistence	See FEIS.	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Land Use	See FEIS.	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Noise	See FEIS.	See FEIS.	See FEIS.	See FEIS.	See FEIS.

*Chapter 4 presents a detailed discussion of potential impacts.

CHAPTER 3

AFFECTED ENVIRONMENT

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3. AFFECTED ENVIRONMENT

Chapter 3 of the *Kensington Gold Project, Final Environmental Impact Statement* (FEIS) (USFS, 1992) discusses the environmental resources in the vicinity of the Kensington Gold Project that could be affected by the Proposed Action. The extent of the area analyzed and discussed in this Draft Supplemental Environmental Impact Statement (SEIS) is the same as the FEIS. The terms "study area" and "project area" are defined in the FEIS, and their usage is carried through this document. The project area is the specific area within which all surface disturbance and development activities would occur. The study area is a larger peripheral zone around the project area within which most potential direct and indirect effects to a specific resource would be expected to occur. It should be noted that the study area is different for each resource, depending on the extent of influence the project could have on it (e.g., the study area for socioeconomics is larger than the study area for vegetation). This chapter supplements information presented in the FEIS by summarizing the results of studies completed since its publication in 1992.

Since publication of the FEIS, Coeur Alaska, Incorporated, completed studies that further characterize natural resources in the region of the Kensington Gold Project. The additional studies, conducted to address proposed project modifications and public and regulatory concerns, focused on water quality characterization and the Terrace Area proposed for the potential dry tailings facility (DTF), which is described in Chapter 2 of this Draft SEIS. The U.S. Forest Service Planning Record documents reports detailing all studies conducted for this project.

This chapter only revises sections of the FEIS if new descriptions were necessary or if more recent characterization efforts changed the discussion regarding the affected environment. If a section of the FEIS was not revised, the Draft SEIS references relevant page numbers of the FEIS. The Draft SEIS revises the following sections in Chapter 3 of the FEIS:

- Geology, specifically geochemical characterization of the ore deposit
- Geotechnical considerations
- Surface water hydrology
- Surface water quality
- Ground water hydrology
- Ground water quality
- Aquatic resources
- Soils, vegetation, and wetlands
- Socioeconomic environment.

3.1 AIR QUALITY AND CLIMATE

The discussion of air quality and climate has not been revised. Pages 3-1 through 3-3 of the FEIS present a complete discussion.

3.2 TOPOGRAPHY

The discussion of topography has not been revised. Page 3-3 of the FEIS presents a complete discussion.

3.3 GEOLOGY

In general, the description of geology presented in the FEIS has not been revised. Pages 3-4 and 3-5 of the FEIS present a complete description of site geology. The *Kensington Gold Mine Project, Technical Assistance Report* (TAR) (EPA, 1994) indicates that the geochemical characterization of the ore body presented in the FEIS was not representative of the entire geologic deposit, however. Consequently, Coeur Alaska conducted additional chemical analyses that relate the characteristics of the ore to be mined to the potential for water quality impacts. This section summarizes the results of the new analyses. Appendix D provides additional details. The *Technical Resource Document for Water Resources, Kensington Gold Project* (SAIC, 1997) discusses the geochemical characteristics of tailings generated by processing and the geochemical characteristics of the waste rock produced during mining.

Ore characterization studies used 591 drill core samples collected from 39 boreholes that intersect the width of the ore zone and four bulk samples either excavated from the mid-section of the ore body or synthesized by blending previously mined samples and drill cuttings. Bulk samples varied from 1.5 to 5 tons. Geochemical tests of ore materials included acid-base accounting analyses, trace metals analyses, static leach tests, and kinetic humidity cell leach tests.

Static acid-base accounting tests indicate that the net acid-generating potential of the ore is generally low. Acid neutralization occurs as acid generated by sulfide minerals reacts with carbonate minerals. Both mineral types are present throughout the ore body. The average total sulfur content of the ore body is 1.32 percent, but locally ranges from 0.24 percent to 2.95 percent, as determined from 39 length-weighted drill core intercepts of the ore body (average values across the ore zone) and five bulk samples (SRK, 1996a). The drill core intercepts have NP:MPA (neutralization potential:maximum potential acidity) ratios ranging from 2.2:1 to 77:1 (SRK, 1996a), with a median value of 12.7:1, indicating that most are net neutralizing. Only 4 of the 39 drill core intercepts have NP:MPA ratios less than 5, and only 1 has a ratio less than 3.

Trace metals analyses were conducted on drill core and bulk samples to define the compositional variability of the ore body. The major constituents of most ore samples are aluminum, calcium, iron, magnesium, manganese, phosphorous, and sodium. Despite variability among samples, most length-weighted drill core composites have chromium, copper, cobolt, and zinc contents exceeding 10 parts per million (ppm) and cadmium, lead, molybdenum, and tellurium contents exceeding 1 ppm (Coeur, 1996b). Median values for mercury and selenium are 88 parts per billion (ppb) and 400 ppb, respectively (Coeur, 1996b). Antimony, arsenic, beryllium, bismuth, lanthanum, tin, and tungsten are typically below minimum detection limits in most drill core composites. Bulk ore samples tend to have higher contents of antimony, arsenic, and nickel and lower cadmium than the drill core composites, but otherwise have similar compositions (Coeur, 1996b; SRK, 1996a).

Kinetic humidity cell tests conducted on a 3.8-ton bulk ore sample were used to determine the potential for the ore to contribute metals to surface and ground waters. Results show that leachates remained neutral to slightly alkaline for the 20-week test period, with pH values ranging from 6.9 to 8.9 (Lakefield Research, 1995). Acidity was not detected in any samples. Sulfate concentrations generally ranged between 10 mg/l and 50 mg/l, with all sample concentrations measured below 150 mg/l. Most analyte concentrations remained comparatively constant following the initial flush (week 0), and no analyte concentrations increased with time. The concentrations of most transition metals and arsenic, beryllium, phosphorous, antimony, selenium, and tellurium occurred at or below analytical detection levels in most samples.

3.4 GEOTECHNICAL CONSIDERATIONS

Pages 3-5 through 3-9 of the FEIS identify faults and describe seismic activity within the Kensington Gold Project area. The FEIS indicates that the maximum credible earthquake would have a magnitude of 6.5 to 7.0 on the Richter Scale. This would result in a peak ground acceleration of 0.5 to 0.6 gravity.

Pages 3-7 and 3-8 of the FEIS also describe the local terrain and its potential to generate landslides, avalanches, and other mass movements. Because steep slopes characterize much of the area surrounding the Kensington Gold Project, additional studies of avalanche chutes were conducted to facilitate project design and layout and to address issues identified in the TAR. The study results are summarized below. Pages 3-7 to 3-8 of the FEIS outline avalanche- and landslide-prone areas in the region bounded by Lions Head Mountain to the north, Berners Bay to the south, and Lynn Canal to the west. Areas with evidence of landslide and avalanche activity were located by examining aerial photos for places devoid of heavy spruce and hemlock forest, regions with steep (greater than 30 percent) slope angles, and areas with snow accumulation and avalanche paths.

Since publication of the FEIS, the snow avalanche potential within the Sherman Creek drainage was studied in detail (Fesler and Fredston, 1994). The study involved field investigations, including analysis of tree size (age and age variation), tree species, and evidence of avalanche-induced damage. Vertical aerial photography, oblique aerial photography, and historical records, including accounts and photographs, were used to help determine run out limits and event frequency.

Figure 3-1 depicts the distribution of avalanche hazard potential. The zones include "high potential hazard," "moderate potential hazard," "low potential hazard," and "no hazard." A high potential hazard is characterized as having return periods of 3 to 30 years and/or a horizontal impact pressure normal to flow of 600 pounds per square foot. Moderate potential hazard zones have return periods of 30 to 300 years and/or horizontal impact pressure normal to flow of less than 600 pounds per square foot. Low potential hazard zones have forested slopes of 30 to 55 degrees and/or open slopes of 25 to 30 degrees. Avalanches are not typical in these areas, but could occur as a result of deforestation or surface disturbances caused by construction.

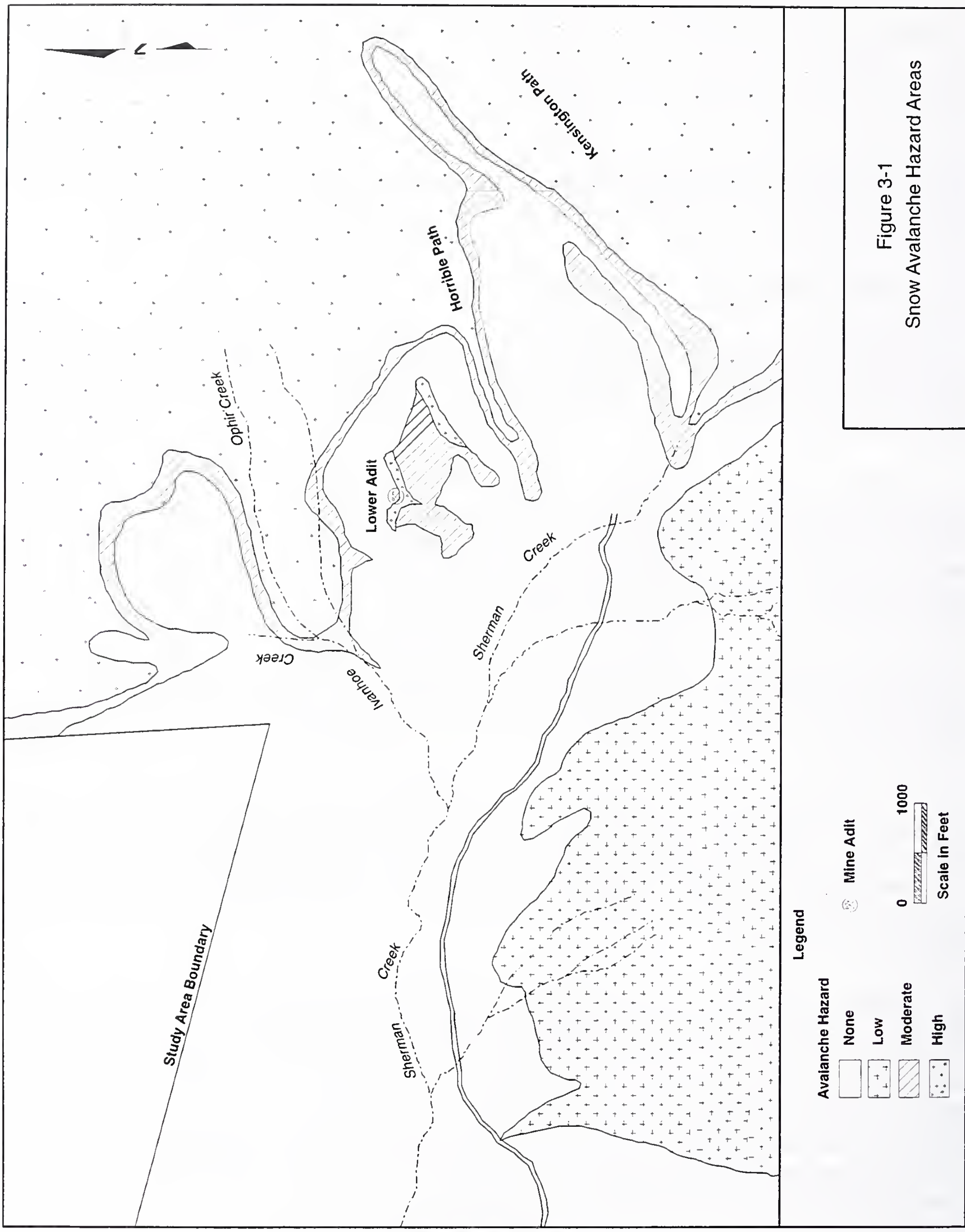

Figure 3-1
Snow Avalanche Hazard Areas

Areas having gentle slopes are classified as no hazard, although the potential for small rock falls and avalanches exists.

3.5 SURFACE WATER HYDROLOGY

Studies describing the flow of surface water in the project area have been refined since publication of the FEIS. Refined models better define the baseline hydrology of the area and have helped to improve the design of hydrologic control structures. Other refinements were based on an analysis of precipitation data from three stations near the site: Eldred Rock (period of record 1941, 1943-1973), the Jualin Project (period of record 1928-1929), and the Juneau Airport (period of record 1949 to present).

Estimated temperature variations and evapotranspiration rates at the project site were not revised from the previous estimates described on pages 3-2 and 3-10 of the FEIS.

The Kensington Gold Project, as proposed, would be located in the Sherman Creek watershed. The watershed, situated at the western foot of Lions Head Mountain in the Kakuhan Range of the Coast Mountains, is typical of other drainages in this region of Southeast Alaska. Slopes are typically very steep with surface cover varying from exposed bedrock at higher elevations to muskeg forests and meadows in lower regions. The main stem of Sherman Creek flows from the base of Horrible Hill and discharges into Lynn Canal at Comet Beach.

The hydrologic regime of a watershed such as Sherman Creek is determined by regional climate and physical characteristics that include geomorphologic and other parameters, including soil type and depth, basin aspect, vegetative cover, and stream channel geometry and gradient. This section reviews and discusses these characteristics and the responses they produce in the project area.

3.5.1 Climatic Conditions

The regional maritime climate produces high annual precipitation as a result of the onshore, up-slope movement of moist air. Snowfall contributes a significant portion of the total annual precipitation in the watershed, with contributions increasing with elevation. There are no glaciers or lakes within the basin; however, a large snow pack can exist throughout the summer at the higher elevations (Knight Piesold, 1996).

The Eldred Rock weather station, located on Lynn Canal approximately 7.5 miles north of Comet Beach, is the closest long-term weather station to the project site. The Juneau Airport station is the only other long-term weather station in the region, but it is located approximately 40 miles south of the site. Eldred Rock receives approximately 16 percent less rainfall than the Juneau Airport, based on a study comparing 15 years of concurrent data (Knight Piesold, 1996). Both the Eldred Rock station and the Juneau Airport station are at or near sea level.

Precipitation data from the Eldred Rock station have been used to estimate precipitation at the project site. To account for increasing precipitation with increasing elevation (orographic

effects), conservative assumptions were applied to the Eldred Rock data to obtain precipitation estimates at various elevations in the Sherman Creek watershed. Average annual precipitation at the mouth of Sherman Creek (sea level) is assumed to be approximately 47 inches, which is the value recorded at the Eldred Rock station. Based on this value, estimated average annual precipitation is 58 inches at 800-feet elevation (where proposed mine operations would be located) and 200 inches at 5,000-feet elevation (Knight Piesold, 1996). Precipitation at the proposed DTF site, the western margin of which is at an elevation of approximately 250 feet, is expected to be slightly higher, but not significantly greater, than that estimated for Eldred Rock. Estimates of the mean monthly precipitation at 800-feet elevation, presented in Table 3-1, were derived by increasing the monthly averages at Eldred Rock by 25 percent to account for orographic effects.

The value for the 24-hour probable maximum precipitation (PMP) event at the site was revised in response to regulatory and public concerns. This value is not measured, but is a conservative estimate that reflects a theoretical maximum amount of precipitation that could occur at a given location. Previous estimates for PMP were reevaluated to account for the severe orographic effects at the project site (Knight Piesold, 1996; USDOC, 1983). After further analysis, the PMP value for this Draft SEIS was revised to 17.26 inches from 15.8 inches, as indicated in the FEIS.

Table 3-1. Average Monthly and Average Annual Precipitation at the 800-Foot Level

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Precipitation (inches)*	11.0	6.8	5.4	4.0	4.8	3.3	2.6	3.0	2.2	3.1	4.5	7.5	58.3
Percentage of Annual	18.9	11.7	9.2	6.9	8.3	5.7	4.5	5.2	3.8	5.3	7.8	12.8	100.0

*Data are estimated by increasing data from Eldred Rock Station (1941; 1943-73) by 25 percent to account for orographic effects.

3.5.2 Watershed Characteristics

The FEIS describes three watershed areas in the project area defined by the Sherman Creek, Sweeny Creek, and Slate Creek drainage basins. The Sweeny Creek and Slate Creek basins are not discussed in the Draft SEIS because proposed operations would not occur in these basins. Pages 3-12 and 3-13 of the FEIS describe these basins. A fourth watershed area has subsequently been identified as the proposed location for the DTF. This small region, which lies between Sherman Creek and Sweeny Creek basins, is referred to as the Terrace Area drainage basin.

Sherman Creek Drainage Basin

The Sherman Creek basin has an area of 2,683 acres (4.19 sq. miles) and ranges in elevation from sea level to 5,000 feet. The watershed contains three sub-basins, which flow into the main channel of Sherman Creek at an elevation of approximately 500 feet. The sub-basins, which contain the drainages of Ivanhoe Creek, Ophir Creek, and upper Sherman Creek, are characterized by high channel densities and numerous unnamed (and unmapped) secondary channels that intermittently flow to the main channels. Upper Sherman Creek is that portion of the creek that occurs upstream of the confluence with Ophir Creek. Lower Sherman Creek refers

to the creek below the confluence with Ophir Creek. Figure 3-2 shows the stream channels within the Sherman Creek basin.

The Ivanhoe Creek sub-basin has an area of approximately 658 acres (1.03 sq. miles) and ranges in elevation from 700 to 5,000 feet. Much of the watershed lies above timberline with many actively eroding bedrock slopes. Snowpack can persist throughout the summer in the upper portion of the sub-basin, which can be heavily affected by avalanches and rock slides. Vegetation in the lower portion of the sub-basin consists of sparse coniferous trees and shrubs (see page 3-44 of the FEIS). Ivanhoe Creek is a short, steep-gradient mountain channel (WEST, 1996).

The Ophir Creek sub-basin comprises approximately 499 acres (0.78 sq. miles) and ranges in elevation from 500 to 5,000 feet. The sub-basin is similar to the Ivanhoe Creek sub-basin insofar as a large portion occurs above timberline and has a sparse vegetative cover. Snowpack can persist throughout the summer in a small area of the upper sub-basin. The Ophir Creek sub-basin contains two subparallel tributaries: a southern tributary that forms the main stem of Ophir Creek and a northern tributary. These channels are rocky, have steep gradients, and are sparsely vegetated. Runoff from the Ophir Creek sub-basin is fast and can account for as much as 90 percent of the peak flow to lower Sherman Creek (Kensington Venture, 1989).

The upper Sherman Creek sub-basin has an area of approximately 700 acres (1.09 sq. miles) and ranges in elevation from 500 to 4,000 feet. Approximately 20 percent of the area occurs above timberline. Below timberline, the vegetative cover consists mostly of coniferous trees. The sub-basin contains two drainages: the main stem of Sherman Creek and South Fork Sherman Creek. The upper reaches of the Sherman Creek channel are deeply incised with steep gradients.

The lower Sherman Creek contributing area ranges in elevation from sea level to 500 feet and covers an area of approximately 826 acres (1.29 sq. miles) between Lynn Canal and the confluence of Ophir Creek and upper Sherman Creek. The moderately to deeply incised channel has a low gradient. Vegetation covers most of the lower portions of the basin.

As described on page 3-10 of the FEIS, the Sherman Creek basin contains soils that have moderate infiltration rates when thoroughly wetted. The soils have a thick, permeable peat layer that overlies clean sands and gravels derived from the underlying fine-grained till deposits. Shallow ground water locally occurs where permitted by soil thickness and slope gradient.

Terrace Area Drainage Basin

The site proposed for the DTF is situated in a small terrace area that consists of its own watershed between the lower main channel of Sherman Creek and the lower main channel of Sweeny Creek (Figure 3-3). Although the watershed area ranges from sea level to 1,400 feet, more than 50 percent occurs at elevations less than 250 feet. The basin has a catchment area of

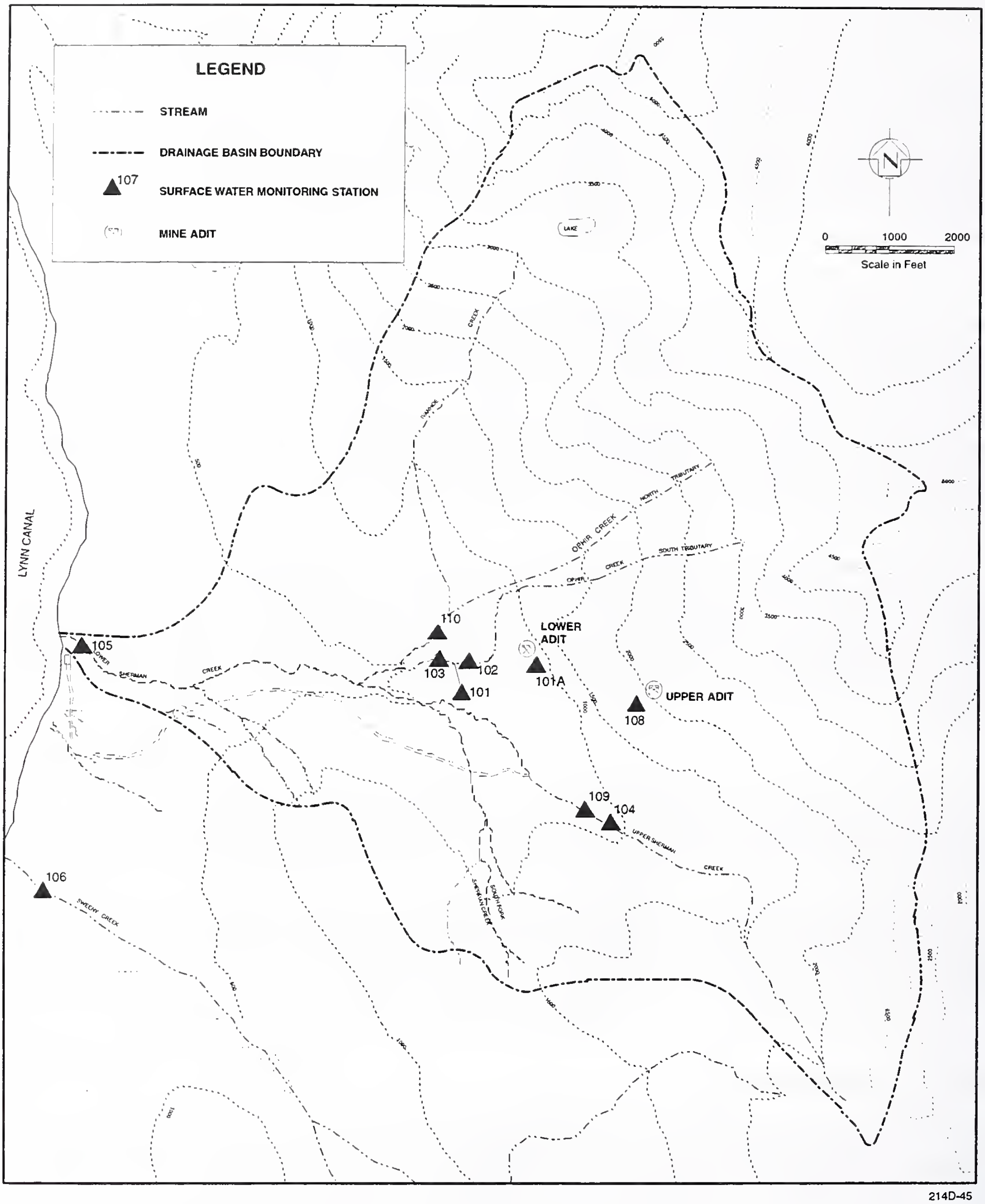

Figure 3-2. Sherman Creek Drainage and Surface Water Monitoring Stations
(Source: Adapted from Montgomery Watson, 1996a and SRK, 1996d)

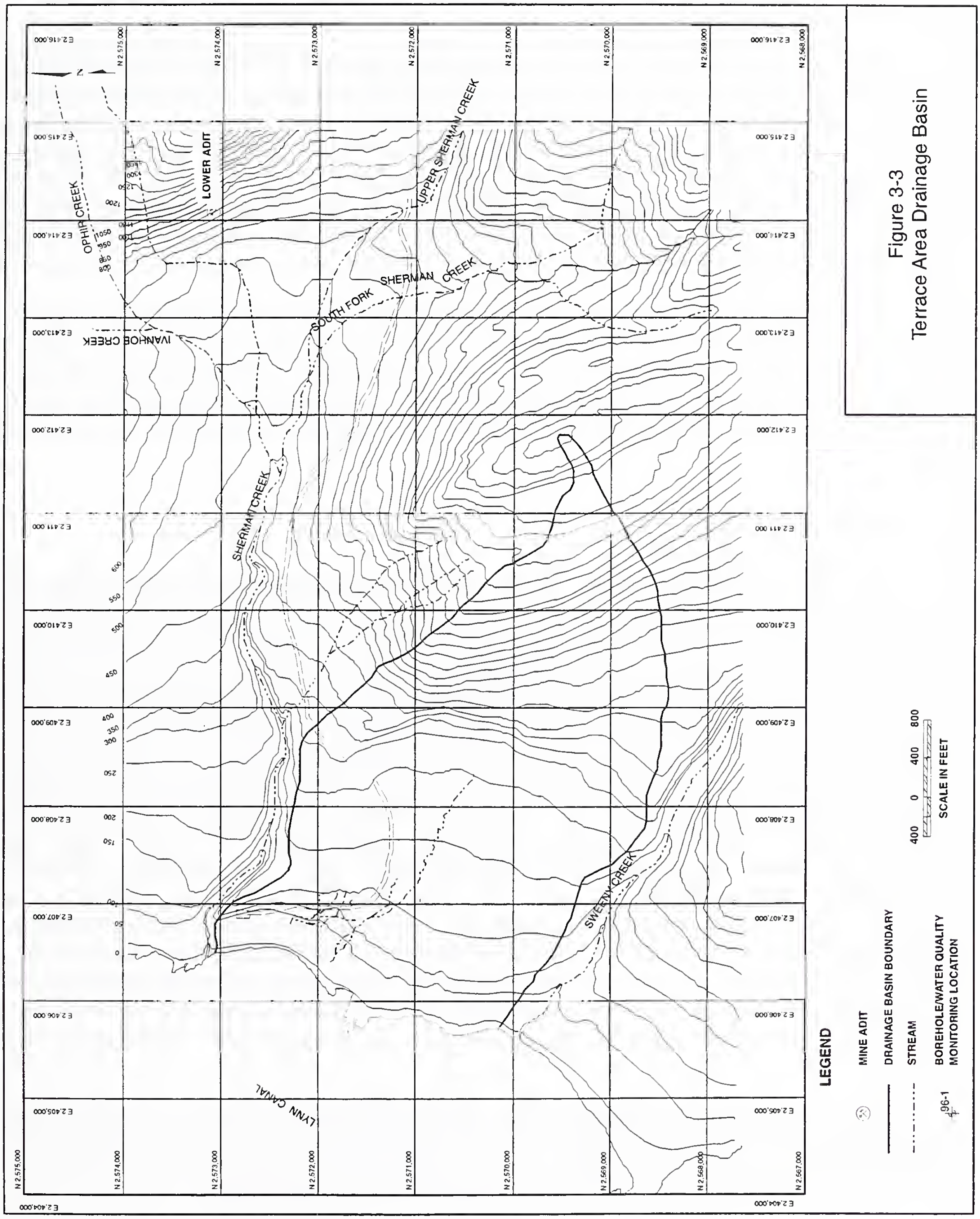

Figure 3-3
Terrace Area Drainage Basin

330 acres (0.51 sq. miles), most of which drains internally through a series of small, unnamed stream systems to Comet Beach. Runoff from the basin does not flow into Sweeny Creek or Sherman Creek.

A May 1996 field study conducted to characterize the basin identified 18 separate stream channels that combine to form 6 small stream systems in the area above and east of the proposed DTF site (Konopacky Environmental, 1996b). Four of these stream systems drain westward into Lynn Canal, supplying drainage to the non-contributing sub-basin. The headwaters or drainage areas for these four stream systems initiate in or slightly above and to the east of the proposed DTF site. At the time the field study was conducted, flow from these four streams was not observed to outfall into Lynn Canal via surface flow. Rather, observable flow terminated at Comet Beach. The final drainage to Lynn Canal was assumed to occur through the subsurface.

Headwaters and drainage areas for the two remaining stream systems initiate above and to the north-east of the proposed DTF footprint. These streams join Sherman Creek slightly upstream of the fish passage barrier, which is located approximately 1,200 feet upstream of Lynn Canal. Although these small stream systems and their associated drainage areas contribute runoff to lower Sherman Creek, they do not drain the part of the watershed that would host the proposed DTF.

3.5.3 Stream Flow

Figure 3-2, presented previously, depicts the location of surface water monitoring stations in the Sherman Creek and Sweeny Creek drainages. Monitoring stream flow at most stations is difficult because of the severe climate and steep topography (Montgomery Watson, 1996a). In addition, stream courses have been noted to change abruptly or to migrate over time in some of the measured reaches. Many creeks exhibit intermittent flow. Dynamic conditions such as these are common in high mountain, steep-gradient channels, and accurate and consistent stream flow measurements are difficult to obtain. Data collected from the site area are of limited use for establishing an accurate, long-term record of stream flow. Consequently, flow data from the upper stations have been used primarily to characterize the relationship of high and low flow conditions to water quality. In some cases, flow measurements have not been reported because extremely low flows have precluded accurate measurement. Table 3-2 summarizes observed high and low stream flow measurements from the monitoring stations where flows were recorded. The *Technical Resource Document for Water Resources* (SAIC, 1997) provides a detailed description of these data. Figures 3-4 through 3-6 outline flow duration curves for stream flows at stations 110, 109, and 105, respectively. These curves outline the percentage of time that specific flows are expected to be exceeded at these stations. These data often are used in determining minimum instream flow requirements and in permitting withdrawals from streams.

Flows in the four Terrace Area basin streams that discharge into Lynn Canal were measured during a field characterization study of the area of the proposed DTF (Konopacky Environmental, 1996b). Measured flow rates were low in the four stream channels, with the

Table 3-2. Observed Stream Flows Within the Sherman Creek Drainage

Station	Low Flow		High Flow	
	Cubic Feet/Second	Date	Cubic Feet/Second	Date
101	0.2	March 1990	1.7	November 1991
103	0.4	February 1995	32.8	October 1991
104	Replaced with Station 109			
105	2.3	February 1995	105	November 1991
109	1.1	January 1991	32.7	June 1992
110	1.2	March and November 1992	26.8	July 1992

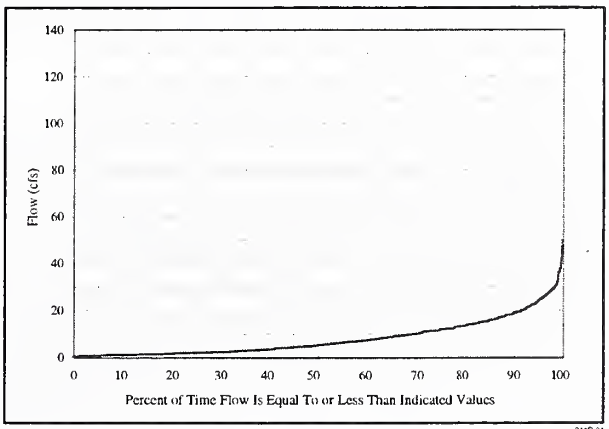

Figure 3-4. Flow Duration Curve for Station 110

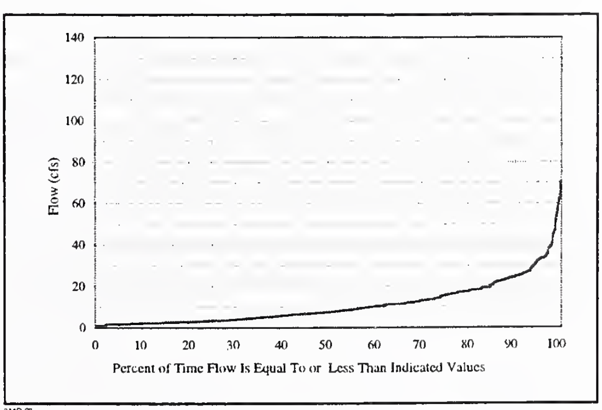

Figure 3-5. Flow Duration Curve for Station 109

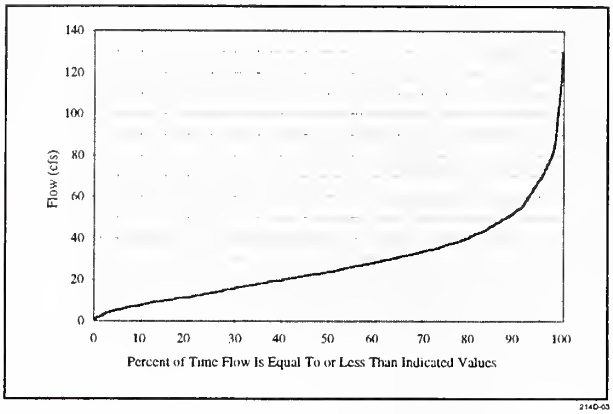

Figure 3-6. Flow Duration Curve for Station 105

maximum observed flows ranging from 0.004 to 0.06 cubic feet per second (cfs) (2 to 25 gallons per minute [gpm]) and the minimum measured flows ranging from 0.002 to 0.01 cfs (1 to 5 gpm).

Stream Flow Modeling

A long-term data base has not been established for stream flow in Sherman Creek and its tributaries. Consequently, a regional analysis procedure was used to estimate the characteristic monthly and annual variations in stream flow. Regional analysis is a statistical procedure based on the assumption that streams and rivers in watersheds in the same geographical region will respond to precipitation events in a hydrologically similar manner. The procedure allows stream flow in ungauged streams to be estimated from records collected from gauged streams. In conducting the analysis, 36 similar drainage basins with long-term flow records were initially evaluated in Southeast Alaska and British Columbia (Knight Piesold, 1994). Seven of these drainage basins were determined to have characteristics similar to the Sherman Creek watershed. Data from the seven drainage basins were combined with the information available from the Sherman Creek basin to perform the regional analysis (Knight Piesold, 1994). Table 3-3 outlines the general characteristics of the drainage basins.

The FLOOD computer model was used to perform the regional analysis and provide estimates of characteristic flows for Sherman Creek and its main tributaries (Knight Piesold, 1994). Table 3-4 shows the estimated average monthly flows for Sherman Creek derived from the analysis. The program also calculates estimates for peak daily flows and peak instantaneous flows, as well as 7- and 30-day annual low flows for each tributary and for a range of return periods. Peak daily and peak instantaneous flows often are used for design purposes. Low flows are important in conducting water quality evaluations and determining minimum stream flow requirements for fisheries. Tables 3-5 and 3-6 present the estimated most probable peak daily flow and most probable peak instantaneous flow by return period, respectively. Table 3-7 provides the estimated most probable 7-day annual low flows for important return periods.

Table 3-3. Basin Characteristics of Stream Flow Stations Selected for Regional Analysis

Station Name	Years of Data	Basin Area (sq. miles)	Max Basin Elevation* (feet)	Proximity to Site (miles)	Basin Orientation
Sheep Creek near Juneau	31	4.57	4,200+	51	SE to NW
Montana Creek near Auke Bay	16	15.50	4,000+	38	NW to SE
Lake Creek at Auke Bay	10	2.50	2,000	39	NW to SE
Auke Creek at Auke Bay	16	3.96	2,000	40	NW to SE
Greens Creek near Juneau	11	22.80	4,600+	55	E to W
Lawson Creek at Douglas	5	2.98	3,300	48	SW to NE
Fish Creek near Auke Bay	20	13.60	3,400+	42	SE to NW
Sherman Creek at Comet Beach	2	3.65	4,000+	NA	E to W

*Values estimated from USGS 1:250,000 map of Juneau.
NA = Not applicable.
Source: Adapted from Knight Piesold, 1994.

Table 3-4. Estimated Average Monthly Stream Flow for Sherman Creek at Comet Beach*

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Stream Flow (cfs)	36.7	21.4	10.2	9.1	8.4	9.4	15.8	44.0	45.1	30.9	31.6	34.9	NA
Percentage of Annual	12.5	7.1	3.4	3.1	2.7	3.3	5.2	15.0	14.8	10.5	10.8	11.6	100.0

*Sherman Creek distribution calculated as an average of seven regional stations and historic Sherman Creek data.
NA = Not applicable.

Table 3-5. Estimated Most Probable Peak Daily Flow by Return Period

Sub-Basin	Peak Daily Stream Flow (cfs)					
	Average Annual	2-year	10-year	25-year	100-year	200-year
Upper Sherman Creek	56	63	103	124	154	169
Ophir Creek	42	46	77	92	114	125
Ivanhoe Creek	55	61	101	121	151	166
South Fork Sherman Creek	15	15	24	29	36	40
Sherman Creek at Comet Beach	194	221	364	436	543	596

Source: Adapted from Knight Piesold, 1994.

Table 3-6. Estimated Most Probable Peak Instantaneous Flow by Return Period

Sub-Basin	Peak Instantaneous Flow (cfs)				
	2-year	10-year	25-year	100-year	200-year
Upper Sherman Creek	146	293	367	476	530
Ophir Creek	109	217	272	353	394
Ivanhoe Creek	143	287	360	467	520
South Fork Sherman Creek	34	69	86	112	125
Sherman Creek at Comet Beach	315	1,033	1,294	1,679	1,870

Source: Adapted from Knight Piesold, 1994.

Table 3-7. Estimated Most Probable 7-Day Annual Low Flows by Return Period

Sub-Basin	7-Day Annual Low Flow (cfs)	
	2-year	10-year
Upper Sherman Creek	0.45	0.22
Ophir Creek	0.32	0.16
Ivanhoe Creek	0.42	0.21
South Fork Sherman Creek	0.11	0.06
Sherman Creek at Comet Beach	1.55	0.75

Source: Adapted from Knight Piesold, 1994.

3.6 SURFACE WATER QUALITY

The surface water monitoring stations discussed previously have been used to monitor the surface water quality and the existing mine drainage discharge. Monitoring stations include the 800-foot lower adit (station 101A), the existing mine drainage settling ponds (station 101), the south tributary of Ophir Creek (stations 102 and 103), lower Sherman Creek (station 105), upper Sherman Creek (stations 104 and 109), the historical Kensington upper adit at the 2,050 foot level (station 108), and the main stem of Ophir Creek (station 110). Water quality monitoring was initiated in 1987 at stations 101A, 103, 104, and 105. The remaining stations were added between 1988 and 1991. In addition, water quality monitoring has been conducted in the adjacent Sweeny Creek basin (station 106) since September 1987. This station was established to provide comparative water quality data from a nearby, undisturbed drainage basin. Page 3-13 of the FEIS presents data from these sites. The following discussion includes these data and monitoring data collected from these sites since publication of the FEIS. Table 3-8 presents data on parameters of potential concern in evaluating potential water quality impacts of project alternatives, and Appendix E summarizes data for all parameters. In general, water quality monitoring results are consistent with those anticipated for a mineralized area, with various metals detected intermittently at most monitoring stations.

3.6.1 Sherman Creek Drainage Basin

Based on water quality analyses, surface water within the Sherman Creek watershed is classified into two types. Stations 101 and 103, which are influenced by water discharging from the 800-foot adit, have calcium sulfate-type water. The remaining monitoring stations have calcium bicarbonate-type water.

Water quality data were evaluated in light of stream flow records to determine whether correlations exist between discharge and water quality parameters. Because stream flow records for the upper monitoring stations are temporally inconsistent, statistically robust correlations could not be established for individual monitoring stations. Consequently, evaluations compared each station's water quality data to the stream flow record from lower Sherman Creek (station 105), which offers the longest, most consistent record in the basin and is located along a stream reach with a relatively stable streambed.

Statistical analyses do not reveal strong correlations between 41 measured water quality parameters and stream flow at station 105. However, potential weak to moderate correlations are noted for 14 measured water quality parameters that include conductivity (related to salinity) as measured both in the field and in the laboratory, dissolved copper, dissolved lead, nitrite, sodium, calcium, sulfate, carbonate, bicarbonate, total alkalinity, hardness, total dissolved solids (TDS), and sodium adsorption ratio. All of these parameters, with the exception of nitrite concentration, have inverse correlations with stream flow. An inverse correlation is one in which the measured parameter increases as stream flow decreases. Nitrite showed increasing measured concentrations with increasing stream flow.

Table 3-8. Summary of Surface Water Data (August 1987 – October 1995)

Station[a, b, c]		As (µg/l)	Cd (µg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Hg (µg/l)	Ni (µg/l)	Se (µg/l)	Ag (µg/l)	Zn (µg/l)	NO_3-N (µg/l)	NH_4-N (µg/l)	pH (s.u.)	TDS (mg/l)	TSS (mg/l)
Station 101	Mean	1.9	NA	NA	9.0	1.3	NA	NA	NA	0.12	11	2,775	1,793	7.9	539	12
	Min	0.7	*<0.2*	*<10*	2.7	1	*<0.05*	*<10*	*<5*	0.1	10	10	10	6.8	70	1
	Max	5.6	*<2*	*<50*	150	20	*<1*	*<20*	*<5*	1	60	39,100	22,600	8.3	1,268	140
	Detects	19	0	0	21	17	0	1	0	17	30	78	60	89	86	63
	Non-detects	55	74	74	53	57	74	73	74	57	44	10	24	0	0	24
Station 101A	Mean	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.2	93	NA
	Min	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*<200*	*<10*	6.7	74	NA
	Max	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*200*	*<50*	7.6	140	NA
	Detects	0	0	0	0	0	0	0	0	0	0	1	0	5	5	0
	Non-detects	0	0	0	0	0	0	0	0	0	0	4	5	0	0	0
Station 102	Mean	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	637	NA	7.2	28	NA
	Min	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10	*<10*	7.0	22	0
	Max	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2,510	*57*	7.6	41	13
	Detects	0	0	0	0	0	0	0	0	0	0	6	1	6	4	2
	Non-detects	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Station 103	Mean	1.8	NA	NA	4.1	4.4	NA	NA	NA	0.17	12	3,169	718	7.3	243	3.6
	Min	0.59	*<0.2*	*<10*	2.1	1	*<0.05*	*<10*	*<5*	0.1	10	90	20	5.7	31	1
	Max	50	*<2*	*<50*	50	217	*<1*	*<20*	*<5*	1.1	60	36,000	9,590	8.0	996	33
	Detects	11	1	0	15	17	0	3	0	14	30	84	59	93	90	50
	Non-detects	60	70	71	56	54	71	68	71	57	41	8	29	0	0	34
Station 105	Mean	0.47	NA	NA	3.1	1.1	NA	NA	NA	0.09	7.7	774	54	7.4	71	4.2
	Min	0.55	*<0.2*	*<10*	2.3	1	*<0.05*	*<10*	*<5*	0.1	10	10	6	6.0	22	1
	Max	0.81	*<2*	*<50*	30	36	*<1*	*<20*	*<5*	1.1	50	19,200	350	8.0	194	120
	Detects	6	0	1	13	12	0	2	0	10	19	81	50	92	88	47
	Non-detects	64	70	69	57	58	70	68	70	60	51	10	37	0	2	36
Station 106	Mean	NA	NA	NA	5.3	5.4	NA	NA	NA	0.13	7.5	419	65	7.4	65	4.6
	Min	*<0.5*	*<0.5*	*<10*	5	1	*<0.05*	*<10*	*<5*	0.1	10	15	10	6.3	20	1
	Max	*5*	*<2*	*<50*	25	256	*<1*	*<20*	*<5*	1.1	40	14,200	1,120	8.1	130	85
	Detects	5	2	0	14	15	0	5	0	12	17	71	45	82	79	47
	Non-Detects	55	58	60	46	45	60	56	60	48	43	11	37	0	0	25
Station 108	Mean	NA	NA	NA	6.4	0.74	NA	NA	NA	0.19	8.3	122	39	7.6	57	5.7
	Min	*<5*	*<0.5*	*<10*	5	1	*<0.1*	*<10*	*<5*	0.1	10	10	40	7.0	26	1
	Max	*<5*	*3.4*	*<10*	19	4	*<0.1*	*<10*	*<5*	0.7	20	310	120	7.9	102	28
	Detects	0	1	0	7	3	0	0	0	7	5	16	6	17	14	12
	Non-detects	11	10	11	4	8	11	11	11	4	6	1	11	0	0	3
Station 109	Mean	1.2	NA	NA	4.3	0.76	NA	NA	NA	0.11	7.0	459	60	7.4	54	3.4
	Min	0.5	*<0.5*	*<10*	5	1	*<0.05*	*<10*	*<5*	0.1	10	10	10	5.7	16	1
	Max	2.8	*<2*	*<50*	30	3	*<1*	*20*	*<5*	1.3	30	15,500	1,380	7.85	110	73
	Detects	13	1	0	11	13	0	4	0	10	16	77	36	78	78	52
	Non-detects	47	59	60	49	47	60	56	60	50	44	1	42	0	0	19
Station 110	Mean	NA	NA	NA	4.3	3.9	NA	NA	NA	0.1	10	214	55	7.4	31	1.7
	Min	*<0.5*	*<0.2*	*<10*	2	1	*<0.05*	*<10*	*<5*	0.1	10	30	20	6.7	8	1
	Max	*<5*	*<2*	*<50*	41	186.5	*<1*	*<20*	*<5*	1.7	150	535	670	7.7	80	8
	Detects	1	1	0	13	10	0	1	0	9	14	45	24	54	48	24
	Non-detects	53	53	54	41	44	54	53	54	45	40	8	25	0	6	30

a. Minimum and maximum detected values are shown for sets with sufficient data for robust statistical analysis. Italics indicate overall minimum and maximum values (considering non-detects) for sets with insufficient data for robust statistical analysis.
b. NA—"No Data Available for Analysis" indicates no analyses were conducted for constituent.
c. All metals are total recoverable.
Source: Montgomery Watson, 1996a.

Monitoring station 101 (settling ponds) was established to monitor discharge water quality from the settling ponds used to treat mine drainage from the 800-foot adit. Concentrations of total aluminum, total iron, and total manganese were reported above their minimum detection limits for some samples collected between 1989 and 1993; other metals were not detected or occasionally measured at concentrations near their minimum detection limits in these samples. The samples with higher metal concentrations were generally collected during periods of exploratory drilling and adit work within the mine. Since 1993, no analytes have been measured above their minimum detection limits.

Monitoring station 101A (mine drainage from the 800-foot adit) was sampled on five dates between 1987 and 1989. Dissolved iron was measured at concentrations above its minimum detection limit of 10 parts per billion (ppb) in four of the five samples. The average iron concentration of the four samples was 282 ppb, although the data vary from 20 ppb to 1,200 ppb. Other metals typically were not detected. This site has not been monitored since publication of the FEIS.

Monitoring stations 102 (south Ophir Creek tributary) and 110 (north of Ophir Creek tributary) establish baseline water quality conditions above exploratory operations on Ophir Creek (Montgomery Watson, 1996a). Data from station 102 are limited and cannot be statistically analyzed; however, they suggest that water is generally low in dissolved constituents and turbidity. Data from station 110 show few detections of metals with concentrations typically measured near the minimum detection limit. Although lead commonly was not detected, concentrations of total lead (186.5 ppb) and dissolved lead (57 ppb) were recorded in January 1992.

Monitoring station 103 (south Ophir Creek tributary) is located downstream of the discharge point from the settling ponds used to treat mine drainage from the 800-foot adit (station 101). The water at station 103, which is characterized as calcium sulfate-type, has a chemistry that more closely resembles ground water than surface waters from other sites (except station 101). This indicates that water quality at station 103 is strongly affected by the mine drainage discharge. Low concentrations of total lead have been recorded occasionally at levels near the minimum detection limit, with measured concentrations of 1 to 2 ppb, ranging up to 10 ppb, in March and October 1992. Samples collected in January 1992 contained 217 ppb of total lead and 62 ppb of dissolved lead. These data are higher by more than 2 orders of magnitude than the lead concentrations measured on any other sampling date. Other metals typically were not detected or were occasionally measured at concentrations near their minimum detection limits.

Monitoring station 105 (lower Sherman Creek) provides an overall characterization of water quality in the Sherman Creek watershed. Concentrations of total iron and total manganese have been measured above their minimum detection limits with relatively higher concentrations being reported occasionally. Other metals are typically undetected or, in the case of lead, occasionally measured at concentrations near their minimum detection limits.

Monitoring station 109 (upper Sherman Creek) also provides background data above exploratory operations. Metals typically were not detected or were measured at concentrations

near their minimum detection limits in these samples. This station was established to replace station 104, which was located in an unstable stream reach.

Elevated concentrations of nitrate, ammonia, and orthophosphate were detected in several samples collected from stations 101 and 103 between 1988 and 1990. These detections coincide with the period when explosives were used during exploration of the upper and lower adits. The presence of cyanide also has been reported at these two stations in correspondance with the elevated concentrations of nitrate and ammonia. Cyanide is not known to have been used at the site and is not expected to occur naturally. It should be noted, however, that cyanide can be falsely detected when high concentrations of nitrate are present if specific laboratory procedures are not applied. Section 3.8 discusses cyanide in greater detail.

3.6.2 Terrace Area Drainage Basin

Water quality samples were collected in June 1996 from two of the unnamed stream systems in the Terrace Area drainage basin. These samples are the only samples analyzed at the time of this report (Konopacky, 1996b). The sparse data suggest that the baseline water quality of these unnamed streams is similar to that of Sherman Creek.

3.7 GROUND WATER HYDROLOGY

Ground water characterization studies at the Kensington Gold Project site began in 1988 and have continued since publication of the FEIS. Page 3-15 of the FEIS presents the results of studies conducted through June 1991. The following discussion incorporates data presented in the FEIS with data from monitoring activities through October 1995. Studies conducted since June 1991 generally confirm previous characterizations of ground water hydrology and ground water quality in the project area. Recent ground water characterization studies have included the area of the proposed DTF site.

3.7.1 Mine Site Ground Water Flow

Recorded mine water discharge is variable. As reported in the FEIS, mine water discharge previously ranged from 100 to 400 gpm. The majority of the water enters the exploration workings along a northwest-southeast oriented fracture system. As reported in the FEIS, the seasonal variation in ground water flux is believed to be correlated to variations in precipitation and subsequent infiltration through the strata overlying the mine workings.

3.7.2 Terrace Area Drainage Basin

The proposed site for the DTF is located on a terrace above Lynn Canal that is bounded by Sherman Creek to the north and Sweeny Creek to the south. The facility footprint has an average ground slope of approximately 8 percent. Steep, forested slopes occur east of the site.

The terrace is composed of peat and organic soil that overlies sandy glacial till and bedrock. The laterally discontinuous till and soil deposits vary in thickness. The glacial till ranges up to 6 feet in thickness and has a composition that varies from sandy, gravely till to clay-rich till. The generally consolidated till is dense and contains up to 30 percent fines, with occasional large cobble- to boulder-sized clasts of glacial float. The deposit locally is interfingered with alluvial gravels. The bedrock underlying the terrace comprises phyllite and shale. Bedrock is encountered at depths generally between 2.5 and 10 feet across the site, with an average depth of approximately 5 feet. The bedrock is typically unweathered and non-friable, although it has a shallow weathered zone at the surface. The phyllite is oriented nearly vertically. Figures 3-7 and 3-8 present geologic sections through the terrace.

The drainage basin gains water from direct precipitation, hillside runoff, and subsurface flow in the bedrock. Conversely, water is lost through evapotranspiration, infiltration into ground water, and lateral subsurface flow toward Sherman Creek, Sweeny Creek, and Lynn Canal.

All of the upper units have saturated zones and zones of perched water, and ground water is present in the till and bedrock. Piezometers installed in the DTF area identified a perched water zone within or at the bottom of the till layer; the ground water table was identified within the bedrock. The potentiometric surface of the regional ground water table tends to conform to surface topography, but is influenced by the structure of the bedrock. Ground water principally flows from east to west toward Lynn Canal, but flow directions locally deviate toward the unnamed creeks within the terrace area.

Estimated hydraulic conductivities are on the order of 1×10^{-2} cm/sec for the organic mat and 1×10^{-6} to 1×10^{-3} cm/sec for the till; however, in situ or laboratory hydraulic conductivity tests have not been performed on either material. Packer and recharge tests of the fractured phyllite bedrock suggest hydraulic conductivities in the range of 10^{-5} cm/sec. Intact bedrock permeability tests indicate hydraulic conductivity on the order of 10^{-7} cm/sec or less. Because overlying materials typically have higher permeabilities than fractured bedrock, the competent bedrock contact may form a hydrologic boundary.

3.8 GROUND WATER QUALITY

Ground water quality has been monitored during exploration operations in the underground mine and in nine ground water monitoring wells from June 1988 to October 1995. Five more wells were added to the monitoring network in 1990 and 1991. Ground water samples typically have low concentrations of most constituents, which are consistent with the short residence times expected for shallow ground waters in mountainous terrain (Montgomery Watson, 1996a). Figure 3-9 depicts the locations of ground water monitoring wells in the Sherman Creek basin.

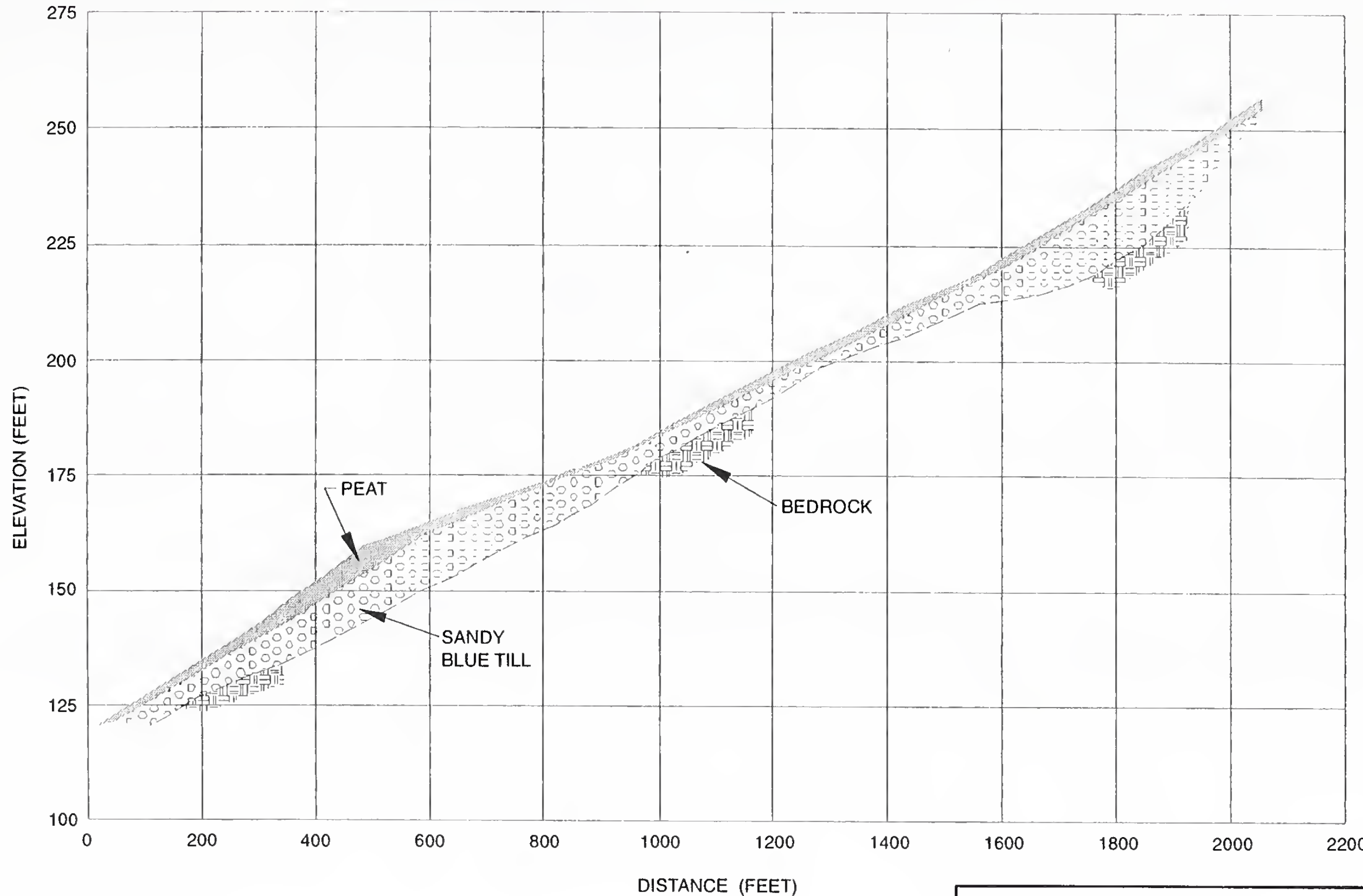

Figure 3-7
Terrace Area Geologic Section
(west to east)
(Vertical exaggeration= 8:1)
(Source: Modified from SRK, 1996b)

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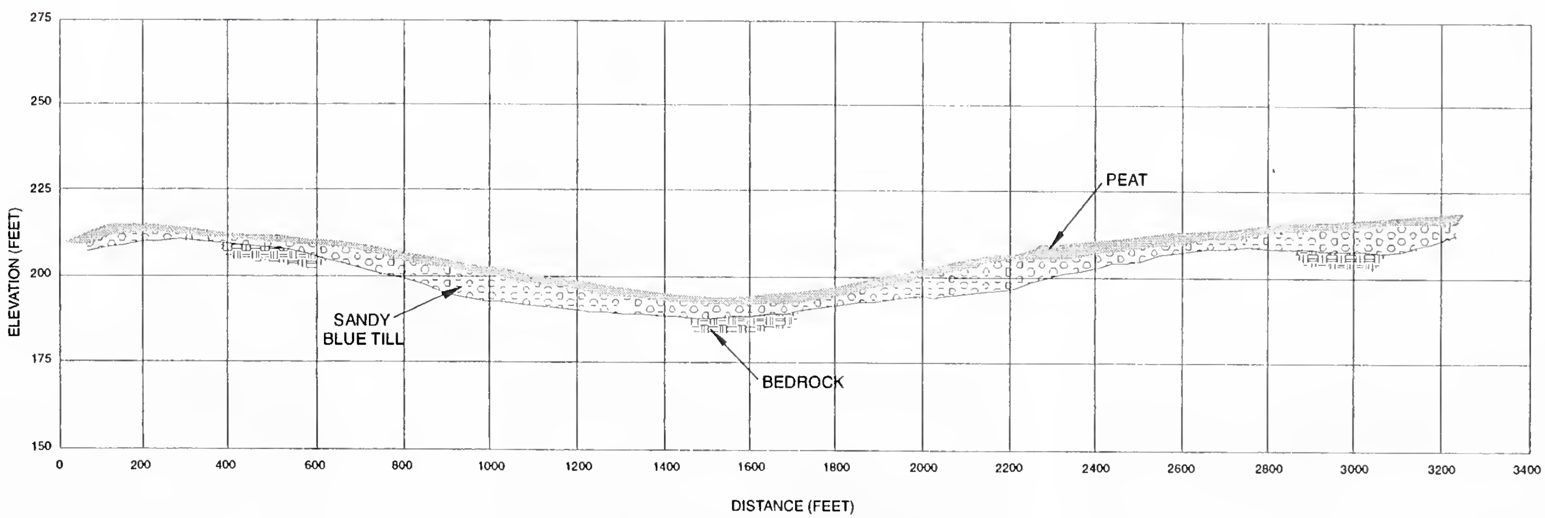

Figure 3-8
Terrace Area Geologic Section
(north to south)

(Vertical exaggeration= 8:1)

(Source: Modified from SRK, 1996b)

214D-30

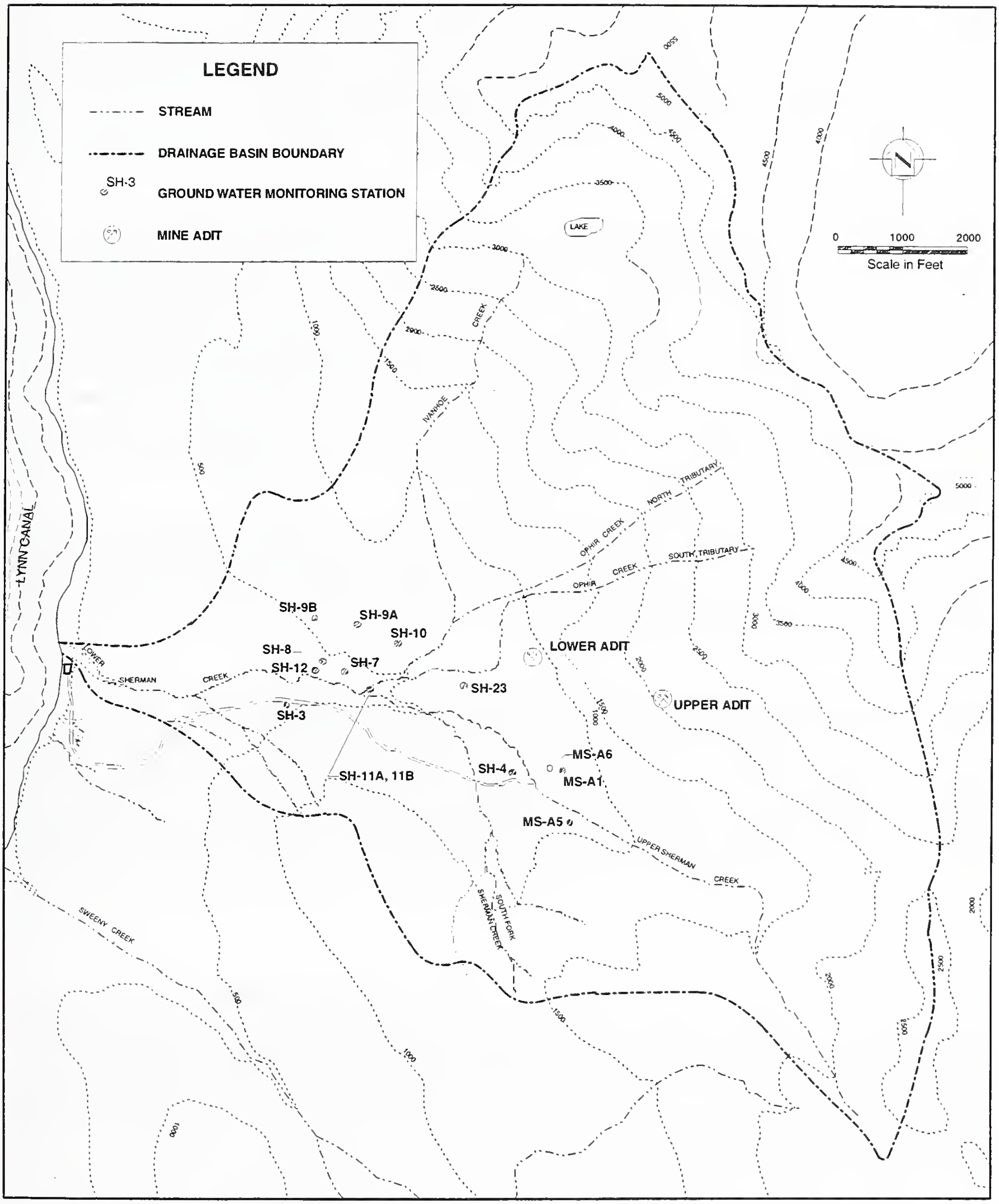

Figure 3-9. Ground Water Monitoring Wells in Sherman Creek Drainage Basin (Source: Adapted from Montgomery Watson, 1996 and SRK, 1996d)

Page 3-19 of the FEIS presents the results of studies conducted from June 1988 through June 1991. The following discussion summarizes those results and presents additional water quality data collected from July 1991 through October 1995, including results from recent characterization studies conducted in the Terrace Area drainage basin. Because of the quantity of data, summary tables of monitoring information are presented in Appendix F. Pages 3-19 and 3-20 of the FEIS provide additional information on ground water quality.

3.8.1 Mine Water

The water discharged from the 800-foot adit and sampled at the sedimentation pond from June 1988 through September 1995 was calcium sulfate-type, with TDS ranging from 70 to 1,268 milligrams per liter (mg/l) (median value of 539 mg/l). The measured pH of these samples ranged from 6.8 to 8.3 (median value of 7.9). Most metals monitored during this period had median values less than their laboratory detection limits. The following metals had median values above their laboratory detection limits: total aluminum (0.17 mg/l), total iron (0.28 mg/l), total manganese (0.04), dissolved manganese (0.03 mg/l), dissolved molybdenum (0.05 mg/l), and total molybdenum (0.05 mg/l). These values are within the range of concentrations typical of natural ground waters in the Juneau area (USFS, 1992).

Analyses of samples collected from the 800-foot adit between December 1989 and October 1990 indicated the presence of cyanide in three forms: free cyanide, weak acid dissociated cyanide, and total cyanide (Montgomery Watson, 1996b). Section 3.8.2 presents a more detailed discussion of cyanide detections.

Samples collected at the 2,050-foot adit from May 1988 through June 1993 are calcium bicarbonate-type water. These samples had TDS concentrations ranging from 26 to 102 mg/l (median value of 57 mg/l) and measured pH values ranging from 7.0 to 7.9 (median value of 7.6). The median values for most metals monitored during this period were less than their laboratory detection limits. The median values for the following metals were above their detection limits: total aluminum (0.2 mg/l), total copper (0.006 mg/l), and total iron (0.24 mg/l). Data have not been collected at this location since June 1993.

3.8.2 Sherman Creek Drainage Basin

Fourteen ground water monitoring wells were installed in the Sherman Creek drainage basin. Data from 10 of these wells (i.e., SH-3, SH-4, SH-9A, SH-9B, SH-11B, SH-12, SH-23, MS-A1, MS-A5, and MS-A6) were used in this Draft SEIS to evaluate ground water quality in the basin. The remaining four wells (i.e., SH-7, SH-8, SH-10 ,and SH-11A) were contaminated by grout during installation, which elevated pH values in their waters; data from these wells were excluded from the following analysis.

Data from the 10 monitoring wells are considered to be representative of natural ground water conditions at the site (Montgomery Watson, 1996a). Five of the wells have been sampled monthly or quarterly from November 1989 to October 1995. Two monitoring wells, SH-9B and SH-23, were added to the monitoring network in April and February 1990, respectively. Three

more wells, MS-A1, MS-A5, and MS-A6, were added to the monitoring network in January 1991.

Ground water in the Sherman Creek drainage is divided into two types based on the Piper and Stiff classification scheme (Montgomery Watson, 1996a). Six of the monitoring wells (i.e., SH-3, SH-9A, SH-9B, MS-A1, MS-A5, and MS-A6) have calcium bicarbonate-type water, which is consistent with the major surface water grouping. The remaining four wells (i.e., SH-11A, SH-11B, SH-12, and SH-23) have sodium-calcium bicarbonate-type water.

The ground water quality monitoring effort focused primarily on characterization for trace metals, as well as TDS, electrical conductivity (a measurement of salinity), pH, turbidity, and temperature. Appendix F and the *Technical Resource Document for Water Resources* (SAIC, 1997) present detailed discussion of water quality data. Samples collected from the Sherman Creek drainage from August 1989 through October 1995 have TDS values ranging from 18 to 1,900 mg/l and pH values ranging from 5.7 to 12.0 (Montgomery Watson, 1996a). Total metal concentrations varied with the time of year and spatially between wells; however, measured concentrations were typically at or near detection limits. Concentrations for total arsenic ranged between 0.98 and 2,900 parts per billion (µg/l); total barium ranged from levels below the detection limit to 7,400 µg/l; total cadmium ranged from levels below the detection limit to 300 µg/l; total chromium ranged from levels below the detection limit to 2,480 µg/l; total copper ranged from 2.2 to 16,200 µg/l; total lead ranged from 1 to 690 µg/l; total mercury ranged from levels below the detection limit to 1.51 µg/l; total selenium ranged from levels below the detection limit to 6.5 µg/l; and total silver ranged from levels below the detection limit to 503 µg/l.

Analyses of ground water samples collected between November 1989 and October 1990 indicated the presence of nitrate, ammonium, orthophosphate, and three forms of cyanide. Nitrate, ammonium, and orthophosphate could be residual chemicals from exploratory blasting at the site, although cyanide is not normally used in explosives. It is also unlikely that cyanide would occur in detectable concentrations under natural conditions in this environment (Montgomery Watson, 1996a). It is likely, therefore, that cyanide was falsely detected. High nitrate concentrations can cause analytical interference if laboratory procedures are not strictly followed.

3.8.3 Terrace Area Drainage Basin

The quality of the ground water in the Terrace Area drainage basin was measured during limited sampling in 1996. Appendix F and the *Technical Resource Document for Water Resources* (SAIC, 1997) present detailed discussion of these data. These samples had mean electrical conductivity (a measurement of salinity) of 370 µmhos/cm and mean TDS values of 229 mg/l. Arsenic, iron, manganese, and zinc were the only dissolved metals detected in a majority of collected samples. Concentrations for total trace metals varied among samples. Total metal concentrations were measured above detection limits for aluminum, arsenic, cadmium, copper, iron, lead, manganese, and zinc in most samples. For some of these analytes (e.g., total aluminum and total iron), measured concentrations varied by more than two orders of magnitude.

In contrast, dissolved anionic constituents were notably less variable. Figure 3-10 shows the locations of monitoring points for the Terrace Area drainage basin.

3.9 AQUATIC RESOURCES

The following descriptions of aquatic resources were derived from site-specific field studies, published reports, and scientific literature. The discussion summarizes the descriptions presented on page 3-20 of the FEIS to the extent necessary to effectively incorporate the results of studies conducted since publication of the FEIS. The following sections pertain to aquatic resources within the area:

- Oceanography
- Marine biota
- Commercial fisheries
- Freshwater biota.

3.9.1 Oceanography

Additional oceanographic studies were conducted since publication of the FEIS. Studies were completed in 1992 and 1995 to provide additional baseline water quality data and address concerns from local fishers regarding circulation patterns in the vicinity of Point Sherman (Kessler and Vigers, 1992; Kessler & Associates and EVS, 1992; Andrews and Wilson, 1995a; Andrews and Wilson, 1995b). The following discussion briefly summarizes the information presented in the FEIS, as well as the results of these more recent studies. Page 3-24 of the FEIS provides a more complete discussion on the oceanography of the site.

Any water discharged from the Kensington Gold Project site would ultimately reach Lynn Canal, a glacially formed fjord that is part of a complex fjord system in Southeast Alaska. The canal is generally between 650 and 1,000 feet deep through much of its central portion, but deepens to 1,950 to 2,300 feet in its southern reaches. Near Point Sherman, in the vicinity of the project area, the canal is approximately 6.2 miles wide. The maximum water depth of 900 feet occurs approximately 1.25 miles from shore. Offshore from Comet Beach, the bathymetry (i.e., bottom topography) is complex due to the presence of rock outcrops, ledges, slopes, and gullies (Dames and Moore, 1988).

The oceanography of Lynn Canal is discussed extensively in the FEIS, as well as by other studies (e.g., McLain, 1969). The results of studies conducted since publication of the FEIS are presented in the *Lynn Canal Oceanographic Data Report* (Rescan, 1990) and a subsequent technical discussion (Rescan, 1991).

McLain (1969) describes the circulation of Lynn Canal as principally estuarine (i.e., seaward surface flow with a corresponding landward deep flow that balances mass transport). The circulation is dominantly tidally driven, but wind also influences the overall circulation pattern. The estuarine flow is typically seasonal, with stronger forcing during the summer

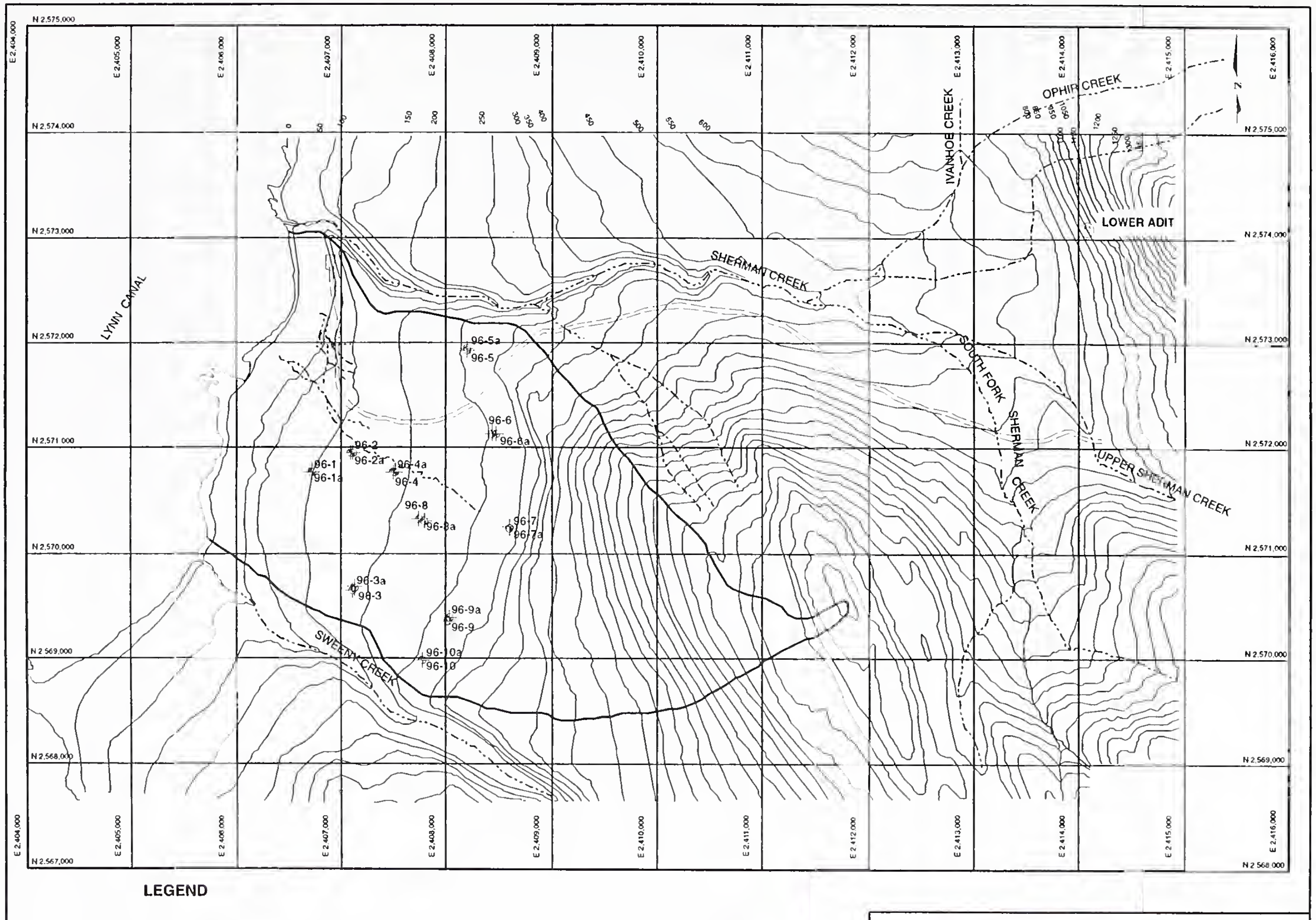

Figure 3-10
Monitoring Points in
Terrace Area Drainage Basin
(Source: SRK, 1996c)

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(July/August) when fresh water input to the canal is at a yearly peak. Tidal flow exhibits a semi-diurnal pattern and is consistent throughout the year. The influence of wind tends to be localized with a greater influence in winter corresponding to the highest average wind speeds.

Point Sherman Region

During development of the TAR, local fishers commented that present measurements taken from current meter mooring location A (Figure 3-11) were not representative of the circulation conditions that exist closer to shore in the vicinity of the proposed marine outfall. The fishers noted that closer to shore, nets had been observed to collapse from the lack of a current and, at other times, to move in circular patterns. Such a recirculation pattern (i.e., eddy) could be caused by tidal flow sweeping past the sharp bathymetry in the Point Sherman/Comet Beach region. The concern over the presence of recirculation centered on its ability to redistribute a marine discharge, particularly as the area supports significant commercial fishing activity (Andrews and Wilson, 1995a).

The implications of this recirculation were considered by Kessler and Vigers (1992). Their analysis of the Rescan (1990) data led them to conclude that such an eddy-like feature would be subject to control by the tidal currents and would be highly variable in strength and position, similar to vortices shed by a turbulent wake. An additional investigation using field measurements of the currents in this area was conducted in March and July 1995 (Andrews and Wilson, 1995a; Andrews and Wilson, 1995b). Currents at two depths were examined along multiple transects aligned approximately perpendicular to the shoreline. Results showed the presence of recirculation during both seasons and during flood and ebb tidal phases. Current flow off the point was consistent with the overall direction of the tidal flow; however, currents in the nearshore areas reversed and turned in complex patterns. Currents in the Point Sherman area are controlled by the bathymetry with some evidence that stronger flows are confined to surface waters of 100 feet or less. Away from the immediate Point Sherman area, current reversals were limited to within 0.25 to 0.50 miles of shore. Differences between the two seasons were not observed, although comparisons with water stratification were not possible.

Water Quality

The water quality of Lynn Canal can be characterized by a number of physical and chemical properties. Parameters of primary concern include water temperature and salinity, which control the density and mixing of different water masses. The presence of suspended solids, metals, and nutrient concentrations is also important because they could be altered by effluent discharges. Changes to the water quality of Lynn Canal could, in turn, affect biological communities. Much of the information available for characterizing water quality conditions is based on data collected by Rescan (1990) during September 1988 and April and June 1989.

Water temperature and salinity characteristics in Lynn Canal are affected by fresh water discharges from rivers (i.e., Chilkat, Chilkoot, Skagway, and Taiya) and creeks, solar heating,

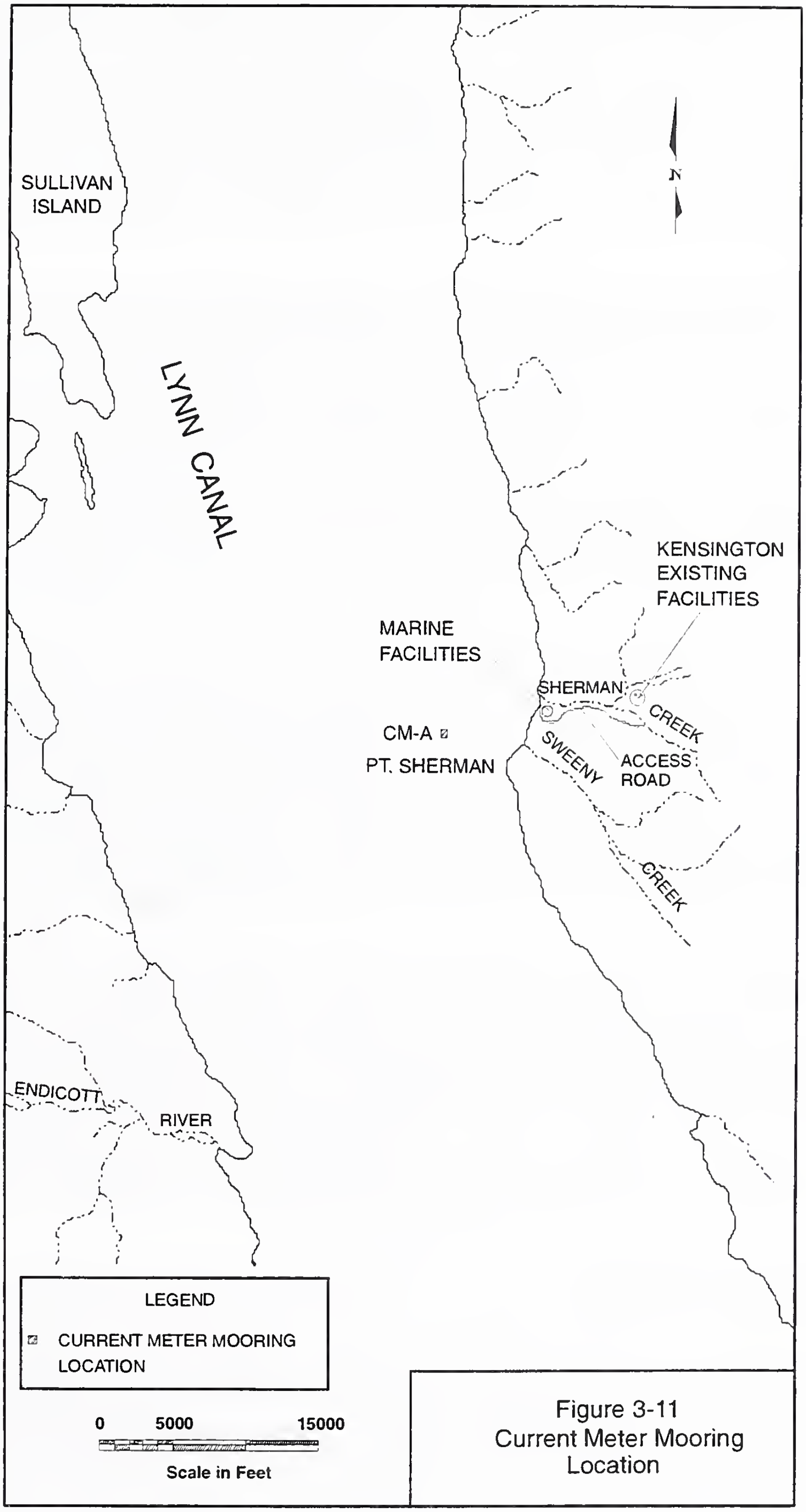

Figure 3-11
Current Meter Mooring Location

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and estuarine circulation patterns. Seasonal differences in water temperature, salinity, and density stratification within the canal are described by Rescan (1991). During summer, a strong density gradient (i.e., pycnocline) forms in the upper portion of the water column due to solar heating and fresh water runoff. The density gradient separates a warmer, less saline surface layer from colder, higher salinity subsurface waters. The density layer is present from approximately June through September. During winter, the density gradients weaken, and the temperature, salinity, and density characteristics of the water column are relatively uniform with depth (Rescan, 1990).

During September, water temperatures decrease from 52° F near the surface to 41° F at 200 feet. Salinity ranges from 21 to 32 parts per thousand (ppt) in the upper 65 feet. Within 65 feet of the surface, light transmittance ranges from 80 to 90 percent and remains uniform at approximately 90 percent below 65 feet. During April, temperature and salinity conditions do not vary appreciably with depth. Water temperatures range from 38 to 40° F, and salinity ranges from 29.5 to 30.5 ppt. The profile for light transmittance is similar to that observed during September, with approximately 90-percent transmittance throughout the water column, except for slightly lower (80- to 90-percent transmittance) values within the upper 82 feet (Rescan, 1990).

Concentrations of total suspended solids (TSS) in Lynn Canal waters range from less than 1.0 to 6.7 mg/l. Based on measurements at seven depths at each of seven locations near Point Sherman during three sampling periods, the mean TSS concentration was approximately 1 mg/l (Kessler & Associates and EVS, 1992). No appreciable differences with depth, location, or sampling period were evident. The pH of Lynn Canal waters range from 7.26 to 8.95, with values slightly higher in summer than in spring. Nitrate concentrations range from nondetectable (<0.005 micrograms per liter [μg/l]) to 0.48 μg/l, with concentrations higher in summer than in spring. Chlorophyll concentrations are highest (≥4.5 μg/l) in June (Rescan, 1990).

Concentrations of dissolved metals in waters at various depths were measured at two locations offshore from the mouth of Sherman Creek. The following concentrations were reported: arsenic, 0.4 to 2.2 μg/l; cadmium, <0.05 to 0.30 μg/l; copper, <0.10 to 2.25 μg/l; lead, <0.05 to 0.80 μg/l; nickel, 0.29 to 0.54 μg/l; zinc, <1 to 53 μg/l; and iron, <0.5 to 20.4 μg/l. Mercury concentrations were consistently below method detection limits (0.05 μg/l). Concentrations for several metals, including cadmium, copper, lead, and zinc, appeared to be slightly higher during April than June or September, which is consistent with the seasonal differences in seawater nitrate concentrations (Rescan, 1990).

Substrate and Sediment Quality

The characteristics of bottom sediments in Lynn Canal in the Comet Beach area change with depth. The intertidal zone on the eastern shore of Lynn Canal between Point Sherman and Independence Creek consists of moderately sloped, cobble beaches with rock outcrops. These beaches are exposed to storm-generated waves from the north, which probably results in considerable physical disturbance and prevents accumulation of finer grained sediments. Cobble and rock substrates extend subtidally to a depth of approximately 30 feet. Below 30 feet, bottom sediments are finer (i.e., smaller particle diameters), consisting of varying proportions of silt,

coarse sand, and gravel, although areas of soft bottom are interrupted by rock outcrops and ledges. Sediments in the deepest, flat-bottomed portions of Lynn Canal consist of relatively fine-grained particles (Dames and Moore, 1988). Based on measurements of bottom sediments from 31 locations offshore from Comet Beach, sand and silt range from approximately 5 to 85 percent and from 15 to 95 percent, respectively (Rescan, 1990). Sediments from inshore locations generally were coarser than those further offshore, although there was considerable spatial variability (Rescan, 1990)

Concentrations of total organic carbon (TOC) in bottom sediments range from 0.25 to 1.27 percent (Rescan, 1990). Sediments from offshore locations generally contain slightly higher concentrations than those from inshore locations, although like grain size, TOC concentrations show considerable spatial variability. Sediment metal concentrations reported by Rescan (1990) generally are consistent with expected background concentrations. For example, ranges for individual metals include arsenic, 6 to 9 milligrams/kilogram (mg/kg); copper, 38 to 48 mg/kg; lead, 10 to 14 mg/kg; iron, 3.6 to 4.8 percent; manganese, 600 to 1,800 mg/kg; nickel, 32 to 46 mg/kg; zinc, 100 to 150 mg/kg; and mercury, 0.04 to 0.09 mg/kg. Cadmium and silver concentrations typically were below analytical detection limits (0.25 mg/kg), although cadmium concentrations have been measured up to 1.1 mg/kg and silver concentrations up to 0.7 mg/kg. These latter values indicate the possibility of either analytical error or human-related effects.

The mean annual deposition rate for solids (i.e., particle flux) was estimated at approximately 900 grams per square meter. Concentrations of metals in sinking particles generally were consistent with concentrations in bottom sediments, except that cadmium, mercury, and zinc were up to several times higher in sinking particles than in bottom sediments (Kessler & Associates and EVS, 1992).

3.9.2 Marine Biota

The following section provides an overview of the biological communities inhabiting Lynn Canal in the vicinity of the proposed project. Much of this information is taken from the FEIS. Characteristics of marine biota are important because aspects of the proposed project, including construction activities, effluent discharges, and/or accidental spills, have the potential to affect biological resources within Lynn Canal.

Intertidal

The invertebrates inhabiting intertidal zones (between low and high tide levels) of Comet Beach are dominated by marine snails (*Littorina siktana*), acorn barnacles (*Balanus glandula*), and blue mussels (*Mytilus edulis*). A brown algae (*Fucus distichus*) occurs in patches on cobbles in the lower intertidal zones. Rock outcrops in this area support higher densities and greater diversity of organisms than cobble areas, because the rocky habitats are not subject to the physical disturbance caused by wave-induced movements of cobbles.

Subtidal

At depths between 6 and 32 feet, dominant invertebrate taxa are green sea urchin (*Strongylocentrotus drobachiensis*), hermit crabs (*Pagurus* spp.), and seastars (*Pycnopodia helianthoides*, *Leptasterias hexactis*, and *Solaster* spp.). Kelp does not occur in the upper subtidal zone near the mouth of Sherman Creek. Basket stars (*Gorgonocephalus* sp.) and brittlestars (*Ophiopholis aculeata* and *Ophiura* sp.) are less motile species, which also occur in the area (Kessler & Associates and EVS, 1992).

The soft-bottom fauna at depths greater than 32 feet are dominated by polychaete worms and, secondarily, by molluscs. A total of 126 infaunal species were present in three samples collected off Sherman Creek (Dames and Moore, 1988). Based on the low densities and biomass, this study concluded that the infaunal community was relatively sparse and that the habitat was relatively unstable.

A number of crustacean macroinvertebrate species occur near the study area. These include crabs, such as Tanner (*Chionoecetes bairdi*), Dungeness (*Cancer magister*), and king (*Paralithodes* spp.), as well as shrimp, including pink (*Pandalus borealis*), coonstripe (*Pandalus danae*), sidestripe (*Pandalopsis dispar*), and spot (*Pandalus platyceros*). Tanner crabs are consistently the most abundant crab species; pink and sidestripe are the most common shrimp species.

Fish

Salmon are the most important fish species in Lynn Canal from an economic standpoint. Salmonids include sockeye (*Oncorhyncus nerka*), pink (*O. gorbuscha*), chum (*O. keta*), coho (*O. kisutch*), and chinook (*O. tshawytscha*), as well as Dolly Varden char (*Salvelinus malma*) and cuttroat trout (*O. clarkii*). Adult salmon returning to Lynn Canal occur primarily along the eastern shore. Spawning migrations vary somewhat by species, but the primary movement occurs between June and November (Archipelago Marine Research, 1991). During spring to early summer, the newly emerged fry congregate in nearshore waters (i.e., within 50 feet of the shoreline) and feed in the beach and rocky reef habitats for periods up to several days. At an age of 1 to 2 months, the fry move into deeper waters and eventually migrate to the open ocean through the summer and fall. The nearshore area off Comet Beach may be part of a larger shoreline region providing rearing habitat for pink and chum fry and sockeye smolts. However, juvenile salmon may be relatively abundant off Comet Beach because of the circulation patterns and diverse habitat associated with Point Sherman (Archipelago Marine Research, 1991).

Other prevalent fish species within Lynn Canal are Pacific herring (*Clupea pallasi*) and Pacific cod (*Gadus macrocephalus*). Typical demersal (bottom-dwelling) fish species in the area include walleye pollock (*Theragra chalcogramma*), arrowtooth flounder (*Atheresthes stomias*), yellowfin sole (*Pleuronectes aspera*), Pacific halibut (*Hipploglossus stenolepis*), rock sole (*Pleuronectes bilineata*), and starry flounder (*Platichthys stellatus*).

3.9.3 Commercial Fisheries

The discussion of commercial fisheries has not been modified from the FEIS (pages 3-35 through 3-37). The FEIS provides harvest data for salmon in Lynn Canal by species for 1985 to 1989. These data have been updated to include more recent information on salmon harvests since 1989. Table 3-9 presents data from 1985 through 1995.

3.9.4 Fresh Water Biota

This section presents additional information that was made available for stream systems, habitat capability modeling, and assessment of rearing populations since publication of the FEIS. Pages 3-37 through 3-44 of the FEIS provide additional information.

The Sherman Creek drainage basin is composed of four streams: upper Sherman Creek, Ivanhoe Creek, the main stem of Ophir Creek, and an unnamed creek called the Ophir Creek tributary. Ophir Creek enters Sherman Creek from the north at an elevation of approximately 440 feet. Most of the Ophir Creek and Ivanhoe Creek drainages have high or very high gradient mountain slope channels. The Forest Service stream classification system designates these drainages as having A1 and A4 channel types, which have little capability to support fish. Dolly Varden char have been captured in Ophir Creek and the Ophir Creek tributary (Konopacky Environmental, 1996a), indicating some fish use of these streams. Although fish are present in these creeks, these creeks are not used regularly for fishing.

Six small stream systems between Sherman and Sweeny creeks in or near the Terrace Area basin were identified and sampled for fish in 1996 (Konopacky Environmental, 1996b). Flows in all identified channels were low, ranging from 1 to 25 gpm. Fish were not captured in any of the systems.

Table 3-9. Commercial Salmon Harvests in Upper Lynn Canal (1985–1995) (in numbers of fish)*

Harvest Year	Sockeye	Coho	Pink	Chum
1985	303,241	98,290	200,192	672,202
1986	289,906	82,121	38,115	381,382
1987	415,881	53,630	165,748	392,938
1988	351,876	81,537	208,423	377,768
1989	471,934	50,307	110,436	123,671
1990	357,418	63,070	101,035	210,532
1991	307,811	128,365	5,472	210,189
1992	286,035	108,753	351,562	245,247
1993	173,113	59,952	11,336	306,586
1994	171,729	140,764	147,306	685,449
1995	88,572	79,949	15,613	568,468

*Chinook salmon harvests are not reported because they are a minor component of the commercial harvest.
Source: ADF&G, 1996.

Trace Element Concentrations in Fish Tissues From Sherman Creek

Baseline levels of nine trace elements (i.e., silver, arsenic, cadmium, chromium, copper, mercury, nickel, lead, and selenium) were measured in fish from the Sherman Creek drainage (Konopacky Environmental, 1996a). Elemental concentrations were reported per gram of wet or dry weight for whole fish. Five streams in the drainage system were sampled for fish: lower, middle, and upper Sherman Creek; Ophir Creek; and the Ophir Creek tributary. Prickly sculpin (*Cottus asper*) and pink salmon embryos and fry were collected only from lower Sherman Creek; Dolly Varden were collected from all streams.

As shown in Table 3-10, Dolly Varden from the Ophir Creek tributary had the highest tissue concentrations of all elements except selenium. The levels could be elevated in fish from the Ophir Creek tributary because 1) the fish were collected immediately downstream from the outfall pipe of the existing settling ponds, 2) exploration and construction activity occurred recently in that portion of the drainage, 3) mining activity has been greater historically in that portion of the drainage than in other portions of Sherman Creek, and 4) levels of trace elements in that portion of the drainage are naturally higher than in other sub-drainages (Konopacky Environmental, 1996a).

Mercury concentrations tended to be higher in large char, except in lower Sherman Creek where small char showed the highest levels. Selenium concentrations were highest in fish from the main stem of Ophir Creek followed by fish collected in the Ophir Creek tributary.

Prickly sculpin had higher concentrations of arsenic, chromium, nickel, and lead than Dolly Varden char in lower Sherman Creek, while Dolly Varden had higher concentrations of silver. The concentrations of selenium, cadmium, copper, and mercury did not differ substantially among species.

Table 3-10. Concentrations of Elements (in µg/g [ppm] wet weight) in Dolly Varden Char From the Sherman Creek Drainage[a]

Element	Sherman	Sherman Creek		Ophir Creek		EPA Screening Value (ppm)[b]
	Lower	Middle	Upper	Main	Tributary	
Silver	0.0031	0.0051	0.0023	0.0051	**0.0087**	NA
Arsenic	0.1390	0.1350	0.1760	0.0390	**0.2173**	3.0
Cadmium	0.0320	0.0253	0.0563	0.0547	**0.0727**	10.0
Chromium	0.0727	0.0993	0.0690	0.1203	**0.4570**	NA
Copper	1.1233	1.2800	1.5600	1.6100	**2.4533**	NA
Mercury	0.0149	0.0187	0.0121	0.0189	**0.0201**	0.6
Nickel	0.1920	0.2287	0.1970	0.1913	**0.4497**	NA
Lead	0.0293	0.0282	0.0156	0.0143	**0.0393**	NA
Selenium	0.6367	0.6200	0.6767	**0.9267**	0.7533	50.0

Note: Bolded values are the highest averages per element.
a. Values are averages of all size classes.
b. Screening values based on adult consumption of a single 8-ounce meal per month.
NA = Not applicable.
Source: Konopacky Environmental, 1996a.

Pre-emergent pink salmon fry collected from lower Sherman Creek in April had lower concentrations of the tested elements than did Dolly Varden char or prickly sculpin. A single, combined sample of dead pink salmon embryos and sac-fry collected in April had extremely high concentrations of arsenic, chromium, copper, nickel, and lead. The much lower concentrations in live pre-emergent fry collected in the same field sample probably indicates that the elements were concentrated in the embryos and sac-fry after death.

The concentrations of arsenic, cadmium, mercury, and selenium in Dolly Varden char do not pose a risk to human health via consumption, based on screening values designated by the U.S. Environmental Protection Agency. Screening values for the other five elements have not been established, as depicted in Table 3-10. Hazard quotients for humans were low for all four elements (Konopacky Environmental, 1996a).

Abundance of Spawning Salmon

Surveys of spawning salmon have continued since 1990 (except 1994) in Sherman Creek and were conducted from 1990 to 1993 in Sweeny Creek (Konopacky Environmental, 1994). Pink salmon are the most numerous species, with no established runs of other species. Chum salmon are occasionally present in low numbers. Coho salmon are observed infrequently in Sweeny Creek.

As shown in Table 3-11, the pink salmon runs in both Sherman and Sweeny creeks are strongly cyclic, with even years having greater numbers of returning fish. Pink salmon enter the streams after July 26, and peak escapement occurs around August 24. Sherman Creek downstream from the anadromous fish block was stratified into 12 reaches to facilitate counting. Although all 12 reaches are used for spawning, reaches 3 and 9 show consistently low usage; none of the reaches consistently dominated use. The total estimated escapement for 1992 exceeded 5,800 fish. The fishery takes between 20 and 80 percent of the returning fish, with higher rates occurring during years of high abundance (Hoffmeister, 1996). Consequently, the total pink salmon return to Sherman Creek in 1992 was approximately 10,000 fish.

Table 3-11. Estimated Escapements into Sherman and Sweeny Creeks (1990–1995)*

Year	Number of Fish	
	Sherman Creek	Sweeny Creek
1990	3,805	2,023
1991	160	17
1992	5,888	2,143
1993	55	0
1994	no count	no count
1995	368	no count

*Weekly counts during spawning season and 2-week stream life.
Source: Pentec, 1991; Konopacky Environmental, 1994; Konopacky Environmental data files.

Chum salmon occur sporadically in Sherman and Sweeny creeks (Konopacky Environmental, 1994). The pattern of occurrence suggests that these fish are strays from other nearby streams.

No fish of any species were found during electrofishing surveys conducted in the four unnamed stream channel systems in the Terrace Area drainage basin (Konopacky Environmental, 1996b). In addition, fish were not found in the two unnamed stream channels that drain into Sherman Creek. The lack of fish in these small channels may be due to the low flows that occur during the summer and frozen winter months, the lack of food supply or a viable connection with Lynn Canal, or the presence of numerous fish passage barriers.

Gravel Quality in Spawning Areas

The particle size distributions of spawning gravels can significantly affect the incubation of salmonid eggs (Chapman, 1988). The survival of salmon embryos generally increases with increasing mean particle size and fredle index (i.e., a measure of the pore size and permeability of the sediment), but decreases markedly as the percentage of fine materials increases (Chapman, 1988). High survival rates are observed when the mean particle size exceeds 15 millimeters (mm) and the fredle index exceeds 5. The survival rates decrease significantly when the percentage of material smaller than 0.85 mm exceeds 10 percent (Chapman, 1988).

The size distribution of gravels within the spawning areas of Sherman and Sweeny creeks was measured to obtain baseline information on the particle size distributions (Konopacky Environmental, 1992). A McNeil-type gravel sampler was used to obtain eight substrate core samples from two reaches of each creek on April 23, 1991. Each sample was wet-sieved through the following sieve sizes: 101.60 mm, 50.80 mm, 25.40 mm, 12.70 mm, 6.35 mm, 1.68 mm, 0.42 mm, and 0.15 mm. Sieve data were used to compute the geometric mean particle size and the fredle index value of each sample. Geometric mean particle sizes ranged from 13.15 mm for a sample in the upper reach of Sweeny Creek to 71.66 mm in lower Sherman Creek. Fredle index values ranged from 4.783 in upper Sweeny Creek to 39.746 in lower Sherman Creek. The computed index values were not significantly different between creeks or in the upper and lower reaches of a single creek. A 0.85-mm screen was not used in the baseline sieve analyses; however, none of the samples had more than 10 percent particles smaller than 1.68 mm. The results indicate that the spawning quality of stream gravels is high at all sites.

Aquatic Invertebrate Populations

Benthic macroinvertebrate populations, which provide a significant food source for stream-dwelling fish, are quite sensitive to chemical and physical changes in the stream environment. Both Sherman Creek and Sweeny Creek were sampled with a Surber Sampler in September 1991, July 1995, and December 1995 to obtain baseline information on the benthic macroinvertebrates inhabiting these two project area streams (Konopacky Environmental, 1992; Konopacky Environmental, 1996a).

Sherman Creek was sampled using two sampling designs. In 1991, benthic macroinvertebrates were sampled in two reaches in lower Sherman Creek: a lower reach located

10 to 100 feet upstream from the stream mouth and an upper reach located 950 to 1,000 feet upstream from the mouth. In 1995, five strata throughout the drainage were sampled: lower, middle, and upper Sherman Creek; Ophir Creek; and the Ophir Creek tributary. Sampling in 1991 was conducted with a 300-micron mesh Surber Sampler; in 1995, the mesh was 1,000 microns.

In 1991, annelid worms accounted for 78 percent of the macroinvertebrates sampled in lower Sherman Creek. The insects included five ephemeropteran (i.e., mayfly) families, five plecopteran (i.e., stonefly) families, three trichopteran (i.e., caddisfly) families, and three dipteran (i.e., true fly) families. Densities did not differ between the lower and upper reaches. Shannon-Weaver diversity and evenness indices were used to evaluate 1) the entire invertebrate samples and 2) the non-annelid portion of the sample. The diversity and evenness indices were not different for the lower and upper reaches for all invertebrates and for non-annelid invertebrates.

In 1995, few annelids were caught in the large mesh sampler. The remaining invertebrate species were similar to those observed in 1991, with mean invertebrate densities significantly lower in lower Sherman Creek than in the other four strata. The mean densities across all strata were significantly higher in July than in December. The mean Shannon-Weaver diversity index was not different across stream strata in either July or December, but was higher in December than in July.

In 1991, macroinvertebrate sampling was conducted in two reaches of lower Sweeny Creek (125 to 200 feet and 775 to 800 feet upstream from the mouth) with the 300-micron sampler. Annelid worms were less dominant in Sweeny Creek than in Sherman Creek, comprising 44 percent of the sampled invertebrates (Konopacky Environmental, 1992). The insects included 4 ephemeropteran (i.e., mayfly) families, 4 plecopteran (i.e., stonefly) families, 13 trichopteran (i.e., caddisfly) families, and 4 dipteran (i.e., true fly) families. As in Sherman Creek, differences between the lower and upper reaches were not apparent. Total invertebrate and non-annelid invertebrate densities were statistically higher in Sherman Creek than in Sweeny Creek. The Shannon-Weaver diversity and evenness indices for all invertebrates, however, were statistically higher in Sweeny Creek than in Sherman Creek. The diversity index was not statistically different between streams for non-annelid invertebrates, but the evenness index remained higher in Sweeny Creek.

All four primary functional groups of insects (i.e., collectors, scrapers, shredders, and predators) were present in both streams and in all sampling periods. The collectors were represented by ephemeropterans and chironomids, scrappers by ephemeropterans and trichopterans, shredders by plecopterans, and predators by plecopterans, trichopterans, and dipterans.

3.10 SOILS, VEGETATION, AND WETLANDS

3.10.1 Soils

The baseline description for soils at the site has not changed since publication of the FEIS. Page 3-44 of the FEIS presents a more detailed description of this resource. Appendix G of this Draft SEIS presents background information on soils. This information was taken from Appendix D4 of the DEIS and is referenced in the FEIS.

3.10.2 Vegetation

The baseline description for vegetation at the site has not changed since publication of the FEIS. Page 3-44 of the FEIS provides a more detailed description of this resource. Appendix G presents background information on vegetation. This information was taken from Appendix D4 of the DEIS and is referenced in the FEIS.

The FEIS ruled out the potential occurrence of a number of threatened and endangered plant species, as well as State sensitive species as defined by the Alaska Natural Heritage Program (see pages 3-48 and 3-49 of the FEIS). One species—western paper birch *(Betula papyrifera* var *commutata*)—was identified on the site and was proposed for listing as State sensitive. Subsequent to publication of the FEIS, this species was not listed as State sensitive and, therefore, is not addressed in this Draft SEIS.

The Forest Service released a sensitive species list for the Alaska region in January 1994 that identifies 13 plant species known or suspected to occur within the Juneau Ranger District. These species are crucifer, no common name *(Aphragmus eschscholtzianus),* Norberg arnica *(Arnica lessingii* spp. *Norbergii*), goose grass sedge (*Carex lenticularis* var. *dolia*), pretty shooting star (*Dodecatheon pulchellum* spp. *Alaskanum*), northern rockress (*Draba borealis* var. *maxima*), Kamchatka rockcress (*Draba kamschatica*), davy managrass (*Glyceria leptostachya*), truncate quillwort (*Isoetes truncata*), Calder lovage (*Ligusticum calderi*), pale poppy (*Papaver alboroseum*), Choris bog orchid (*Platanthera chorisiana*), Loose-flowered bluegrass (*Poa laxiflora*), and Kamchatka alkali grass (*Puccinellia kamtschatica*). An additional species, ascending moonwort (*Botrychium ascendens*), is considered sensitive by the U.S. Fish and Wildlife Service and could be added to the Forest Service list in the future.

A 1991 survey of the site documented the occurrence of *Platanthera chorisiana*. *Carex lenticularis* was also observed at the site (ACZ, 1991a). Since this species was not identified to the variety level, it is assumed that the plant observed was the common variety rather than the sensitive species. *Dodecathon* and *Poa* species were also observed but not identified to the species level. Due to the habitat preferences and physical characteristics, respectively, of these species, it is unlikely that the individuals observed during the survey were not sensitive species (USFS, 1997).

3.10.3 Wetlands

The baseline description for wetlands at the site has been expanded since publication of the FEIS. The description of wetlands presented on page 3-47 of the FEIS uses two approaches: 1) a plant community approach that identifies plant communities at the landscape level based strictly on vegetation characteristics and 2) a plant association approach that uses a combination of soils and vegetation characteristics to assign particular plant associations to specific soil types (DeMeo and Loggy, 1989). The plant community approach was used to describe the occurrence of wetlands on a general scale and was not carried forward in subsequent analyses. The plant association approach was carried through the FEIS impact analysis. Page 3-48 of the FEIS briefly discusses wetland functions and value, and Appendix G (Table G-11) of this document presents a summary table. The discussion in this Draft SEIS focuses on "jurisdictional" wetland and wetland habitat aspects within the project area. Quantitative analyses presented in Section 4.8.3 focuses on plant associations and jurisdictional wetlands only.

Figure 3-12 illustrates the extent of jurisdictional wetlands identified within the project area. Certain activities in jurisdictional wetlands are regulated under Section 404 of the Clean Water Act, as administered by the Corps of Engineers and EPA. Jurisdictional wetlands are identified and delineated using the three-parameter approach defined in the Corps of Engineers Wetlands Delineation Manual (Environmental Laboratory, 1987). Under normal conditions, all three criteria—hydrophytic vegetation, hydric soils, and wetland hydrology—must be present at a site for it to qualify as a jurisdictional wetland. For the Kensington Gold Project, 1,123 acres of jurisdictional wetlands were delineated within the project area (SRK, 1997).

An area lacking one or more of the three criteria can still exhibit wetland characteristics (e.g., wetland vegetation). These non-jurisdictional wetlands are not subject to regulatory requirements; however, they are often of interest in terms of the habitat value they provide to wildlife.

One method for describing wetland habitats is the Wetland and Deepwater Habitat Classification System (i.e., Cowardin System), which was developed by Cowardin et al. (1979). This system uses a combination of vegetation and hydrology to classify wetland habitats. Wetlands identified under the Cowardin System are not necessarily jurisdictional. The Cowardin System also forms the basis for National Wetlands Inventory mapping conducted by the U.S. Fish and Wildlife Service.

Classifying wetlands within the project area using the Cowardin System facilitates comparisons with wetlands exhibiting similar characteristics both within and outside Southeast Alaska. Using the Cowardin System, vegetated wetlands in the study area are grouped into four categories: palustrine forested, palustrine scrub-shrub, riverine, and estuarine.

Wetland habitat occurring within the creek drainages and on the adjacent slopes consists of palustrine forested wetlands, whereas the flowing water and channel beds constitute riverine wetland habitat. Forested wetlands are dominated by mountain hemlock (*Tsuga mertensiana*) and Sitka spruce (*Picea sitchensis*) with an understory that includes Alaska blueberry (*Vaccinium*

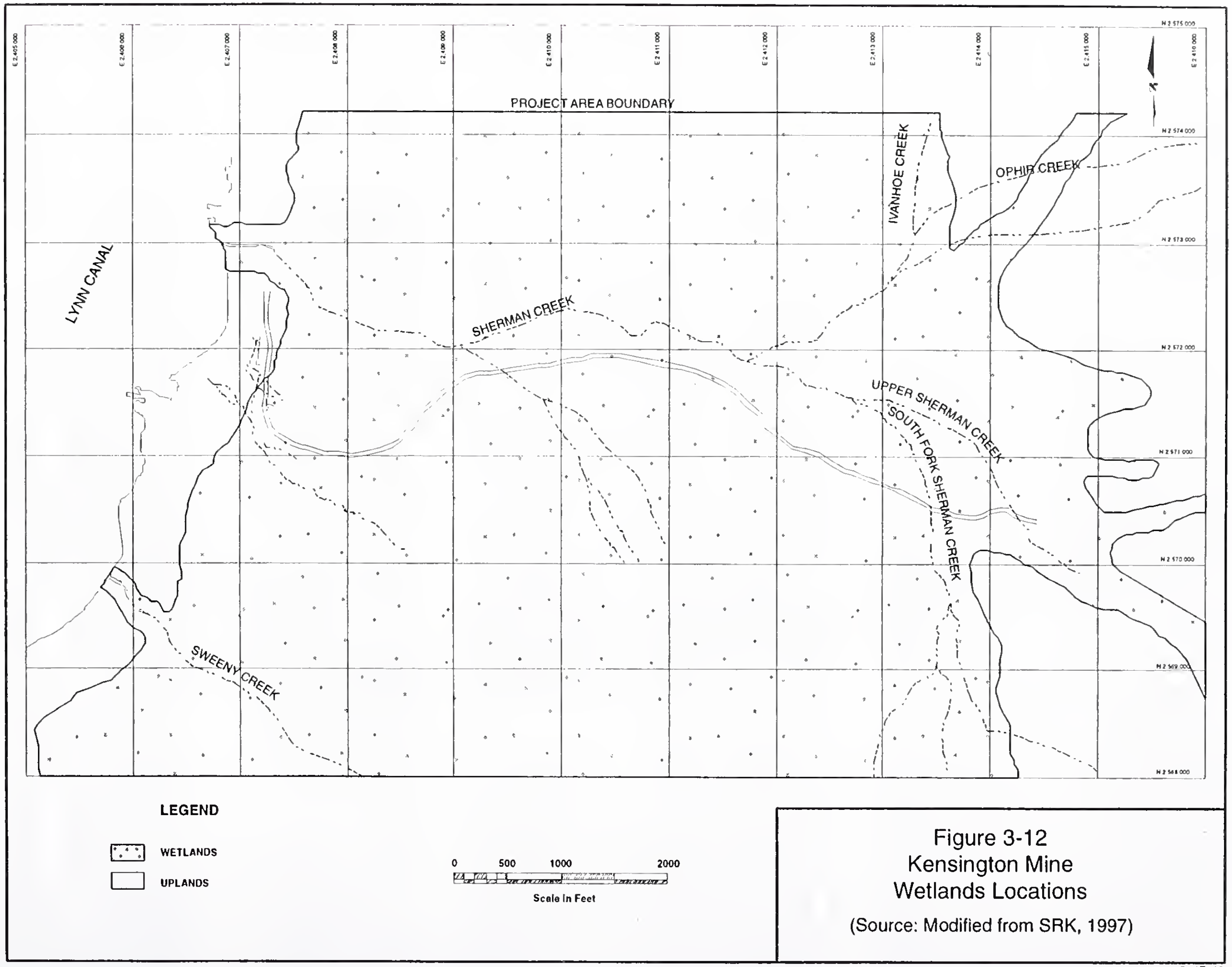

Figure 3-12
Kensington Mine
Wetlands Locations
(Source: Modified from SRK, 1997)

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alaskaense), skunk cabbage (*Lysichitum americanum*), and deer cabbage (*Fauria crista-galli*). Upland inclusions occur within these forested wetlands, primarily in areas where soil or slope conditions are inadequate to support wetland hydrology. The overstory in these upland areas can also consist of hemlock (*Tsuga* spp.) and Sitka spruce, although the understory is dominated by devil's club (*Oplopanax horridum*) and salmonberry (*Rubus spectabilis*). Appendix H provides a species list indicating the wetland status of plants occurring in the project area (ACZ, 1991a).

While upland inclusions can be present throughout the drainages, forested wetlands form the predominant habitat type. This habitat type extends throughout the Sherman Creek and Sweeny Creek drainages, as well as the lower portions of Ophir and Ivanhoe creeks.

Palustrine scrub-shrub wetlands correspond to the muskeg areas, where relatively gentle topography supports the accumulation of dense mats of organic material and saturated soil conditions. Vegetation in these areas is a mixture of herbaceous species, low-growing shrubs, and stunted trees dominated by tufted clubrush (*Scirpus caespitosus*), bog kalmia (*Kalmia polifolia*), and lodgepole or shore pine (*Pinus contorta*). This habitat type occurs on more gentle slopes, such as the Terrace Area and the area east of the confluence of Sherman and Ophir creeks.

National Wetland Inventory maps identify estuarine wetland habitat along Comet Beach (USFWS, 1979). The discussion of substrate and sediment quality in Section 3.9.1 of this Draft SEIS describes this unvegetated, cobble-bedded habitat.

3.11 WILDLIFE

The discussion on the occurrence and abundance of wildlife has not been revised. See page 3-49 of the FEIS.

3.12 RECREATION

The discussion on recreation has not been revised. See page 3-63 of the FEIS for a complete discussion.

3.13 CULTURAL RESOURCES

The discussion on cultural resources has not been revised. See page 3-67 of the FEIS for a complete discussion.

3.14 VISUAL RESOURCES

The discussion on visual resources has not been revised. See page 3-70 of the FEIS for a complete discussion.

3.15 SOCIOECONOMIC ENVIRONMENT

The description of the socioeconomic environment was revised to include data collected since publication of the FEIS. Pages 3-74 through 3-107 of the FEIS provide additional information on this resource. This discussion focuses on socioeconomic conditions in the following areas:

- City and Borough of Juneau
- City and Borough of Haines
- City of Skagway.

These areas are discussed in terms of socioeconomic characteristics, including demographic trends, economic indicators, and capacity of present jurisdictional services.

3.15.1 City and Borough of Juneau

People reside and/or work in the following communities and areas within the City and Borough of Juneau: Juneau, Douglas, North Douglas, Thane, Salmon Creek, Lemon Creek, Mendenhall Valley, Fritz Cove, Auke Bay, and Lena Cove.

The Greens Creek Mine, located west of Juneau on Admiralty Island (annexed by the City/Borough of Juneau in 1994), began operations in 1989, focusing on lead and zinc production. The mine, which employed about 270 workers, suspended production in April 1993. Currently, the mine is being recommissioned for gold and silver production and is scheduled to reopen during spring 1997 with employment expected to reach 230 workers by the end of the year (Kennecott Greens Creek Mining Company, 1996). In addition, the Echo Bay Mines Alaska initiated exploratory activities pursuant to development of the A-J Mine. This effort employed 96 workers in 1994 (Alaska Department of Labor, 1996). In January 1997, Echo Bay announced cessation of its efforts to develop the A-J mine.

3.15.2 Population and Demography

Juneau's population has grown at a steady, moderate pace between 1989 and 1996, adding as many as 3,500 residents. The CBJ Community Development Department estimated a population of 30,209 persons in November 1996. The Alaska Department of Labor provisional estimate of population for the borough as of July 1, 1996, is 29,524. The differences in the two population estimates may be due to timing and methodology.

3.15.3 Employment

Total employment in the Juneau area increased from 13,772 persons in 1990 to 15,812 persons in 1995. Overall employment was up 14.8 percent from 1990, with an additional 2,040 jobs. The largest increase (16.5 percent) was in trade and services employment, which accounted for 338 additional jobs.

While government employment remains the backbone of the Juneau area economy, providing for 43.6 percent of total employment, it has declined in relative importance during the past decade. Between 1980 and 1995, combined trade and services employment grew from 27.1 percent to 37.5 percent of total employment, while government employment decreased from 55.8 percent to 43.6 percent, based on Alaska Department of Labor (1996) statistics (see Table 3-12).

The unemployment rate for the City and Borough of Juneau was 4.5 percent in August 1996. This was slightly higher than the rate (4.4 percent) for the same period in 1995 and reflects the relatively high employment levels during the summer peak. November 1995 unemployment was 6.6 percent.

Income

Table 3-13 presents the 1995 annual payroll and average payroll for both public and private sectors. The total annual income (wages and salaries) in the Juneau area for 1995 was more than $509.3 million. In addition, the average wage for the Juneau area worker in 1995 was estimated at $32,212.

Community and Public Services

The discussion of community and public services in the City and Borough of Juneau has been revised in the following areas:

- Education
- Law enforcement, fire protection, and ambulance services
- Hospital and medical services.

Education

The Juneau area has numerous public schools: five elementary schools, with an additional elementary school under construction for occupancy in school year 1997-98; two middle schools; and one high school. The official count (October 25, 1996) for total enrollment in the Juneau School District was 5,627 pupils. Six privately operated schools provide pre-school and kindergarten through eighth grade education.

Currently, enrollment at two elementary schools—Dzantik'i Heeni Middle School, and Juneau-Douglas High School—exceeds the design capacity of the permanent school facility. Portable classrooms are used to absorb some of the excess enrollment. Marie Drake Middle School, which was closed after the opening of the Dzantik'i Heeni Middle School in fall 1994, was adapted to accommodate high school enrollment in excess of Juneau-Douglas' capacity. Capital Elementary School was reopened temporarily to accommodate about 200 Harborview Elementary pupils until the new Riverbend Elementary School is completed for the 1997-98 school year. Upon completion of the new elementary school, the school district expects to be able to accommodate all elementary pupils in permanent classroom space.

Table 3-12. Employment by Industry for City and Borough of Juneau (1980, 1990, and 1995)[a]

Industry	1980	1990	1995	Percent Change 1980 - 1995
Mining	b	75	187	n/a
Construction	375	414	629	67.7
Manufacturing	92	148	327	255.4
Transportation, Communications, and Utilities	913	911	1,072	17.4
Wholesale and Retail Trade	1,554	2,239	2,920	87.9
Finance, Insurance, & Real Estate	428	496	681	59.1
Services	1,391	2,333	3,017	116.9
Government	6,049	7,099	6,893	142
Federal [c]	1,187	1,056	908	–23.5
State	3,882	4,535	4,315	11.2
Local	980	1,508	1,671	70.5
Total Employment	10,839	13,772	15,812	45.9

a. Refers to employment in industries covered by unemployment compensation insurance.
b. Information withheld for proprietary reasons.
c. Beginning in 1993, Federal employment was corrected for overreporting of approximately 100 workers.
Source: Alaska Department of Labor, 1996; EPA, 1996.

Table 3-13. Non-Agricultural Payroll for City and Borough of Juneau (1995)

Industry	Annual Payroll ($ in thousands)	Average Annual Payroll ($)
Total Private Sector	218,840.5	24,536
Agricultural Services, Forestry, Fisheries, and Miscellaneous	NA	NA
Mining	11,815.1	63,182
Construction	22,982.9	36,539
Manufacturing	10,131.5	30,983
Transportation, Communications, and Utilities	33,672.9	31,411
Wholesale Trade	6,362.1	34,577
Retail Trade	49,508.0	18,095
Finance, Insurance, and Real Estate	20,597.3	30,246
Services	61,880.9	20,511
Unclassifiable	NA	NA
Total Public Sector	290,499.0	42,144
Federal	45,341.4	49,935
State	184,096.0	42,664
Local	61,061.6	36,542
Total Payroll	509,339.6	32,212

NA—Not available because of restrictions on disclosure of data for individual firms.
Source: Alaska Department of Labor, 1996.

Law Enforcement, Fire Protection, and Ambulance Services

Two law enforcement agencies, the Juneau Police Department and the Alaska State Troopers, serve the City and Borough of Juneau. The 45-officer Juneau Police Department is responsible for the Juneau-Douglas area and portions of the Mendenhall Valley, and three State troopers are responsible for the remainder of the borough. Five district fire stations are located in the City and Borough of Juneau. In 1995, 34 firefighters were paid and 100 were volunteers.

Certified emergency medical technicians employed by the fire department provide ambulance services in the City and Borough of Juneau. Four full-time service, radio-equipped ambulances and 34 full-time firefighters who have received advanced life support training provide emergency medical aid in the area.

Hospital and Medical Services

Juneau's health care sector includes the Bartlett Regional Hospital, St. Ann's Nursing Home, and State of Alaska Pioneers Home. The City and Borough of Juneau operate the Bartlett Regional Hospital. Since 1995, the capacity of this facility has been reduced from 64 to 55 beds. Bartlett Regional Hospital handled 13,331 emergency room visits in FY 1996; admitted 3,077 patients, including newborns; and performed 2,089 operations. St. Ann's nursing home provides 45 beds for long-term medical care for the elderly. The recently opened State of Alaska Pioneers Home provides 48 beds for elderly residents, 9 of which are dedicated to long-term nursing care.

Housing

The City and Borough of Juneau Community Development Department preliminary estimate of housing units for November 1996 was 11,523 dwelling units, including 137 live-aboard boats and 27 recreational vehicles. A total of 7,732 units (67 percent of total units) were single-family dwellings, 2,401 multifamily units (21 percent), and 1,225 mobile homes (11 percent). The 1996 average single family vacancy rate was 1.69 percent, the average multifamily vacancy rate was 3.25 percent, and the average mobile home vacancy rate was 0.96 percent. Permit applications for housing units in 1995 totaled 496 units, including 164 houses, 69 zero-lot and townhouse units, 50 duplex units, 113 3-plexes and higher, and 100 other units (e.g., residence hall). Through September 1996, the number of permit applications totaled 299, compared to 338 for the same period in 1995.

In 1996, the average (median) cost for a single family home was $194,900 for a 1,795 square foot home, $234,900 for a duplex (3,240 square feet or 1,620 square feet per unit), $149,900 for an attached (zero lot line) unit (1,173 square feet), and $158,950 for a condominium (1,420 square feet). The median price for lots for sale was $59,900. Construction costs for an average-quality home range between $100 and $110 per square foot.

Fiscal Condition

Revenues and expenditures for the City and Borough of Juneau for the current fiscal year 1997 (adopted operating budget) total $137.2 million. For considering longer term trends,

expenditures during FY 1990 totaled $113.1 million, indicating a total increase of about 21 percent over the past 7 years or an annual average growth rate of 2.8 percent or an amount that barely reflected increases in inflation only.

State sources of $32.2 million in FY 1997 are an important source of revenue for the City and Borough of Juneau, representing approximately 24 percent of the total general fund revenues. Municipal taxes collected by the City and Borough of Juneau amounted to $45.3 million in FY 1997 (33 percent of total budgeted revenues). Property tax revenues and sales tax revenues, including sales, liquor sales, hotel, and tobacco excise taxes, are the major sources, generating almost equal shares at $22.8 million and $22.5 million, respectively. User fees and permits at $46.4 million in FY 1997 are the largest revenue sources, accounting for approximately 34 percent of total budgeted revenues.

Education expenditures were the single largest expense in the City and Borough of Juneau at $42.0 million, accounting for approximately 31 percent of the expenditures in FY 1997. The next highest general government expenditures were for public safety and the Bartlett Regional Hospital.

Transportation

The City and Borough of Juneau is serviced from the outside by both air and water. The Juneau International Airport and adjacent float plane lake provide support facilities for daily passenger and cargo jet services, as well as for several air taxi operators. Commercial passenger jets depart daily to Seattle, Anchorage, Fairbanks, and the larger Southeast Alaska cities. Total airport aircraft operations, which includes all takeoffs and landings by commercial, general aviation, military, and local civil aircraft, reached an all-time high of 156,000 operations in 1995. Passenger arrivals on major air carriers serving Juneau also reached a new high of 246,620 passengers in 1995 (EPA, 1996).

The Alaska Marine Highway System provides mainline service among Juneau and other southeast communities between Skagway and Haines, Alaska, and Bellingham, Washington, as well as feeder service between Juneau and other southeastern ports. Three major barge lines provide Juneau with weekly Seattle freight service—Alaska Marine Lines provides biweekly service to Juneau from Seattle, and Glacier Marine and Northland Service each provide service once a week from Seattle to Juneau (CBJ Harbors, 1996; Alaska Marine Lines, 1996). In 1996, 25 cruise line vessels, carrying 451,000 passengers, made stops at Juneau, representing an increase of 44 percent over 1993 (CBJ Harbors, 1996).

3.15.4 City and Borough of Haines

The City of Haines is the largest community within the Haines Borough. The Alaska Department of Labor population estimate for July 1, 1996, was 1,400 persons for the city and 2,373 for the borough. The community of Klukwan is located north of the City of Haines on the highway, but is not in the Haines Borough.

Population/Demography

The population of Haines fluctuates on a seasonal basis due to an influx of summer transient and semi-permanent resident populations. The population then decreases with the onset of winter when some of the resident population migrates out for winter work while others travel. Peak demands on Haines community services, therefore, are in the summer months. Table 3-14 presents population trends for the Haines Borough.

Employment

Total employment in the Haines Borough was estimated in 1995 at 799 on an average annual basis. Peak month (August) employment stood at 1,296. Table 3-15 provides borough-wide employment by industry for 1995.

In 1995, retail trade and government were the largest employers in the Haines Borough, providing approximately 20.5 percent and 20.0 percent of total employment, respectively, on an average annual basis. During the peak month, manufacturing accounted for 31 percent of the monthly total, with retail trade following at 18.4 percent. Transportation, communications, and

Table 3-14. Population History for Haines Borough

Year	Population
1980[a]	1,680
1985[b]	2,034
1990[a]	2,117
1995[b]	2,295
1996[b]	2,373

a. U.S. Department of Commerce, Bureau of Census, 1980 and 1990 Census.
b. Alaska Department of Labor, 1996.

Table 3-15. Employment Profile for the Haines Borough (1995)*

Employment Category	Average Annual Employment	Peak Month (August) Employment
Construction	58	82
Manufacturing	105	407
Transportation, Communications, and Utilities	149	199
Wholesale Trade	3	2
Retail Trade	164	239
Finance, Insurance, and Real Estate	17	18
Services	143	207
Government	161	142
Total Employment	799	1,296

*Refers to employment in industries covered by unemployment compensation insurance.
Source: Alaska Department of Labor, 1996.

utilities and services also contributed high employment shares of 18.6 percent and 17.9 percent, respectively, on an average annual basis. The Department of Labor data on employment for the Haines Borough in 1995 did not include fishing and mining employment.

The unemployment rate for the Haines Borough was 5.6 percent in August 1996. This was slightly lower than the rate (5.8 percent) for the same period in 1995 and reflects the relatively high employment levels during the summer peak. November 1995 unemployment was 13.7 percent.

Income

Table 3-16 summarizes the total and average annual payroll by industry sector for the Haines Borough in 1995. As shown in the table, manufacturing and construction with similar payroll levels are the primary contributors to payrolls in the borough economy.

Community and Public Services

This section revises the FEIS discussion on community and public services in the City and Borough of Haines in education and law enforcement, fire protection, and ambulance services.

Table 3-16. Non-Agricultural Payroll for Haines Borough (1995)

Industry	Annual Payroll ($ in thousands)	Average Annual Payroll ($)
Total Private Sector	16,628.3	26,104
Agricultural Services, Forestry, Fisheries, and Miscellaneous	NA	NA
Mining	NA	NA
Construction	4,118.8	73,487
Manufacturing	4,467.2	42.953
Transportation, Communications, and Utilities	2,915.4	19,566
Wholesale Trade	91.5	45,766
Retail Trade	2,234.5	13,708
Finance, Insurance, and Real Estate	399.2	24,947
Services	2,331.8	16,306
Unclassifiable	2,331.8	16,306
Total Public Sector	5,388.7	33,679
Federal	524.6	47,689
State	1,477.2	43,447
Local	3,386.9	29,451
Total Payroll	22,017.1	27,555

NA—Not available because of restrictions on disclosure of data for individual firms.
Source: Alaska Department of Labor, 1996.

Education

The Haines Borough School District provides educational services to the community for kindergarten through 12th grade. All borough school facilities in Haines are located on a 16-acre site, which includes recreational facilities and four buildings: the primary, elementary, high school, and vocational buildings. In 1996/97, total enrollment was 444 pupils.

Law Enforcement, Fire Protection, and Ambulance Services

The 10-person City of Haines Police Department is responsible for the City of Haines and two locations outside the city limits (i.e., the city-owned airport terminal and the Lutak Dock and State ferry terminal). The City of Haines volunteer fire department has a force of 50 trained firefighters, 45 of which are on-call. The Haines Fire Department also provides ambulance service. A five-person central dispatching unit handles dispatching for police, fire, and other emergency services.

Housing

According to the City of Haines October 1995 estimate of housing units, a total of 564 units included 336 single-family, 30 zero-lot, 107 multifamily, and 91 mobile homes. Vacancies ranged from 4 percent for single-family and multifamily to 1 percent for mobile homes. With an average vacancy rate of 3 percent, total occupied units amounted to 544 dwelling units. The Haines area includes extensive private land holdings. According to the Assessor's Office, 1,735 parcels are vacant in the borough. Unlike many other Southeast Alaska communities, Haines has a large inventory of vacant privately held land within a short distance of the downtown area. Much of this land is available for purchase and/or residential development.

Comparatively low-cost housing construction is available in Haines. Although residential construction costs in Juneau are more than $100 per square foot, construction costs in Haines are about $80 to $90 per square foot, depending on the quality of the building.

Fiscal Condition

Total budgeted expenditures for the Haines Borough amounted to approximately $3.1 million in FY 1997. An additional $122,300 was spent on facilities (e.g., library, museum, and Chilkat Center) from funds generated by user charges. Approximately 40 percent of borough spending was on public school operations with the balance spent on general administration, cultural facilities, debt service, and capital projects.

Transportation

Haines is one of the most accessible communities in Alaska, with scheduled air and ferry service, as well as a road link to the Alaska Highway System. The Alaska Marine Highway System provides passenger and vehicle service to Haines approximately five times per week. At present, ferry schedules and capacity to Haines are more than adequate to meet the off-season demand. During the summer, however, vehicle space is frequently booked long in advance.

Based on information provided by the Alaska Marine Highway System, passenger and vehicle volumes for 1995 were as follows: passengers embarking - 41,019, passengers disembarking - 40,041, vehicles embarking - 14,478, and vehicles disembarking - 13,732.

Cruise ship activity for Haines was estimated for 1996 at 181 port calls and 94,642 passengers, based on information provided by the City of Haines. Alaska Marine Lines and Glacier Marine barges deliver general cargo weekly. The barges use the Lutak Dock.

3.15.5 City of Skagway

The combination of a deepwater port and good access to the Yukon Territory accounts for Skagway's long history as a trans-shipment center. The area does not have a borough government; however, the city is the second largest in the Skagway-Hoonah-Angoon Census Area (1996 population estimated at 900). The Alaska Department of Labor population estimate for July 1, 1996, was 767 persons for the City of Skagway and 3,816 for the census area.

Population and Demography

At the time of incorporation in 1900, Skagway had approximately 3,000 residents. By 1909, as the gold rush waned, the population was 872 and shrinking. Population has declined since the 1980 census due both to the closure of the railroad in 1982 and the statewide recession of 1986 and 1987. Table 3-17 presents population numbers for Skagway.

Employment

Government agencies do not regularly publish employment and payroll data. A limited amount of Skagway-specific data is available at the statistical sub-area level from the Alaska Department of Labor. It is worth noting, however, that only employees covered under the State's unemployment insurance system are included. Also, employment data indicate that 2 out of 10 industrial categories (i.e., 1) mining and 2) agriculture, forestry, and fishing) are not available because of confidentiality restrictions. Based on this source, total employment comprised 608 full- and part-time jobs in 1995. Retail trade and services had the highest relative shares at 175 and 168 jobs, respectively, representing more than 50 percent of total employment. Transportation is another important employment generator. All three sectors are involved heavily with tourism.

Table 3-17. Population History for City of Skagway

Year	Population
1980[a]	814
1990[a]	692
1995[b]	771
1996[b]	767

a. U.S. Department of Commerce, Bureau of Census, 1980 and 1990.
b. Alaska Department of Labor, 1996.

Unemployment figures for Skagway are combined with those of Hoonan and Angoon. The unemployment rate for the Skagway-Hoonan-Angoon Census Area was 2.9 percent in August 1996. This was slightly lower than the rate (3.6 percent) for the same period in 1995 and reflects the relatively high employment levels during the summer peak. November 1995 unemployment was 7.1 percent.

Income

The annual payroll in Skagway totaled $13.8 million in 1995, with more than 65 percent of the total earned during the second and third quarters. Table 3-18 summarizes the total and average annual payroll by industry sector for Skagway in 1995. As shown in the table, services; retail trade; and transportation, communications, and public utilities are the primary contributors to payrolls in the area economy.

Community and Public Services

The discussion of law enforcement, fire protection, and ambulance services is the only section of community and public services in the City of Skagway revised since publication of the FEIS.

Law Enforcement, Fire Protection, and Ambulance Services

The Skagway Police Department provides public safety for a 433 square-mile area with four full-time officers (one Chief and 3 officers). According to the Skagway Comprehensive

Table 3-18. Non-Agricultural Payroll for City of Skagway (1995)

Industry	Annual Payroll ($ in thousands)	Average Annual Payroll ($)
Total Private Sector	9,784.8	21,274
Agricultural Services, Forestry, Fisheries, and Miscellaneous	NA	NA
Mining	NA	NA
Construction	1,061.9	36,618
Manufacturing	456.5	32,608
Transportation, Communications, and Utilities	2,185.3	34,144
Wholesale Trade	26.9	26.9
Retail Trade	2,684.2	15,338
Finance, Insurance, and Real Estate	146.9	20,985
Services	3,219.3	19,162
Unclassifiable	3.8	3,820
Total Public Sector	4,026.3	27,390
Federal	1,774.6	31,133
State	486.2	40,515
Local	1,765.5	22,635
Total Payroll	13,811,099	22,715

NA—Not available because of restrictions on disclosure of data for individual firms.
Source: Alaska Department of Labor, 1996.

Plan (City of Skagway, 1988), the Police Department does not have sufficient administrative space and holding facilities. Skagway does not have any State police.

The Skagway Volunteer Fire Department provides fire suppression and emergency medical response. The department has 1 paid employee, 30 volunteer firefighters, and about 10 volunteer emergency medical technicians. The department has one ambulance; another will be added in early 1997. Although the department is capable of meeting residential demands for fire suppression services, it is not equipped sufficiently to meet commercial and industrial demands, according to the Skagway Comprehensive Plan (City of Skagway, 1988), and is understaffed during the summer tourist season.

Housing

The U.S. Bureau of the Census counted 404 housing units in Skagway in 1990, 285 of which were occupied. The vacancy rates for homeowners and renters were 8.3 percent and 15.5 percent, respectively, at the time the census was taken (April 1, 1990).

Fiscal Condition

The City of Skagway FY 1997 general fund budget amounts to just more than $1.5 million. In addition to the general fund, there are funds for garbage, water, port enterprise, special sales tax, debt service, tourism, and land sale. The city also collects a sales tax and a property tax. The city provides education and public safety services, water, sewer, solid waste disposal, and a variety of other services to local residents and visitors.

Transportation

The Klondike Highway, which links Skagway to the Alaska Highway System, was opened to year-round traffic in 1986. It provides road access for trucks carrying approximately 500,000 tons of lead/zinc concentrate annually from the Faro Mine in Yukon Territory. The highway also has made Skagway more accessible to travelers. According to the Alaska Visitor Statistics Program, about 79,000 arrived in Skagway via this highway in summer 1995 (The McDowell Group, 1995).

Skagway is the northern terminus of the Alaska Marine Highway System. The ferry provides service year-round, with daily stops in the summer and five stops weekly in the winter. Passenger and vehicle traffic on the ferry has increased considerably since the Klondike Highway was opened for year-round use. Based on information provided by the Alaska Marine Highway System, passenger and vehicle volumes for 1995 were as follows: passengers embarking – 38,899, passengers disembarking – 40,569, vehicles embarking – 8,950, and vehicles disembarking – 9,466.

Based on information provided by the Cruise Lines Agency of Alaska in Ketchikan, 19 cruise ships carried 284,000 passengers to Skagway in 1996. Alaska Marine Lines and Glacier Marine provide weekly scheduled barge service to Skagway from Seattle, the city's principal

supply center. Skagway also has a community airport with charter service provided by various carriers.

3.16 SUBSISTENCE

The discussion on subsistence has not been revised. Page 3-107 of the FEIS provides a complete discussion.

3.17 LAND USE

The discussion on land use has not been revised. Page 3-109 of the FEIS provides a complete discussion.

3.18 NOISE

The discussion on noise has not been revised. Page 3-110 of the FEIS provides a complete discussion.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

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4. ENVIRONMENTAL CONSEQUENCES

This chapter presents the results of analyses of the potential impacts from the four alternatives on each resource discussed in Chapter 3. The scope and level of detail devoted to impact analysis for the different resources are a function of the scoping process and identification of significant issues for the Supplemental Environmental Impact Statement (SEIS).

Alternative A is the No Action Alternative and represents the project components of Alternative F, Water Treatment Option 1, as selected in the January 29, 1992, Forest Service Record of Decision (ROD) with modifications that address the requirements of the *Kensington Gold Mine Project,* Technical *Assessment Report* (TAR) (EPA, 1994). U.S. Environmental Protection Agency (EPA) Region 10 prepared the TAR for the U.S. Army Corps of Engineers (Corps of Engineers), Alaska District. Alternative B is the Proposed Action, and Alternatives C and D are modifications to the Proposed Action based on issues identified during the scoping process.

In accordance with the National Environmental Policy Act (NEPA) and Council on Environmental Quality (CEQ) regulations, Chapter 4 describes the direct, indirect, and cumulative impacts, as well as irreversible or irretrievable commitment of resources, for Alternatives B through D. Alternative A was analyzed in detail in the Final Environmental Impact Statement (FEIS) (USFS, 1992). For the purposes of providing continuity to the analysis and for comparison of alternatives, however, this chapter also summarizes the potential impacts associated with Alternative A. Estimates of cumulative impacts are based on the local geographic area and assume a 16-year life for Alternative A and 14-year life for Alternatives B through D. The projects considered reasonably foreseeable in terms of the cumulative impact assessment are the Lace River Hydroelectric Project, the Juneau access road, the Echo Cove development, and the Jualin Project (see Figure 4-1).

This chapter also describes proposed mitigation measures and best management practices (BMPs) that the operator would employ to minimize potential impacts to environmental resources. Where appropriate, these measures are discussed with the descriptions and analyses of potential impacts for each alternative.

Chapter Organization

This chapter is organized to facilitate comparison of the potential impacts to the environmental resources from the four alternatives and to minimize redundancy caused by common aspects among alternatives. Each section begins by identifying the indicators used to evaluate the potential impacts from each alternative. Each section then describes any potential impacts common to all alternatives. Next, each section summarizes potential impacts of Alternative A; the FEIS provides a detailed discussion. The section then discusses any potential impacts common to Alternatives B through D, followed by descriptions specific to Alternatives B through D. Each section concludes with potential cumulative impacts and a summary.

Table 4-1 outlines issues and indicators that were used to analyze potential impacts to each resource.

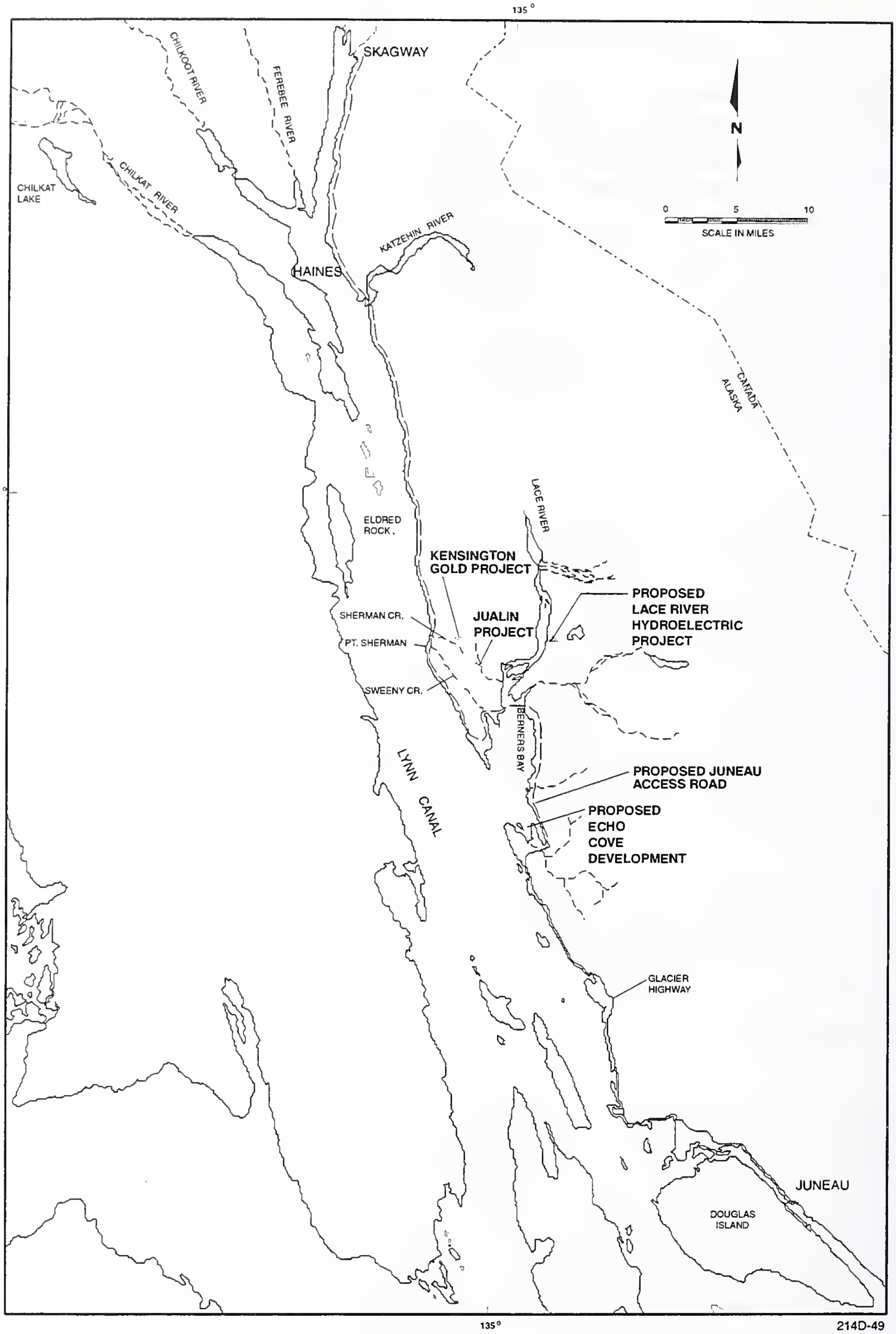

Figure 4-1. Projects Considered for Cumulative Impacts

Table 4-1. Issues and Indicators by Resource

Resource	Issue	Indicators
Air Quality	• Use of diesel fuel instead of liquefied petroleum gas (LPG) for power generation could result in increased air emissions and carbon dioxide.* • The cumulative impacts with other projects in Berners Bay should be considered.	• Emissions and compliance with State and Federal standards and PSD increments • Visual impacts from emissions
Geotechnical	• The visual effects on tourism, especially on cruise ships and ferries, of the proposed changes should be minimized.* • The potential for and effects of failure of the dry tailings facility (DTF) should be considered.*	• Risk and consequences of tailings storage unit failure
Surface Water Hydrology	• The cumulative impacts with other projects in Berners Bay should be considered. • The potential for reduction in fish habitat due to water withdrawal should be considered.	• Changes in stream flow regimes • Physical changes in locations and length of stream segments
Surface Water Quality	• Assurances should be given that the discharges under the NPDES permit meet water quality standards.* • The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.* • The potential for and effects of DTF failure should be considered.* • The potential for adverse impacts to Sherman Creek from sediment in storm water runoff from borrow pits, personnel camp, snow disposal areas, and diversion ditches should be considered. Riparian areas need to be maintained to minimize sediment input to fresh water.	• Increased sediment in stream beds • Projected effluent quality compared to NPDES permit limits • Risk and consequences of accidents and spills
Ground Water Hydrology and Water Quality	• Assurances should be given that the discharges under the NPDES permit meet water quality standards.* • The cumulative impacts with other projects in Berners Bay should be considered.	• Changes in ground water hydrology • Changes in ground water quality
Aquatic Resources - Marine	• The potential for and effects of DTF failure should be considered.* • The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.* • The cumulative impacts with other projects in Berners Bay should be considered.	• Water quality • Sedimentation • Habitat integrity
Aquatic Resources - Fresh	• Assurances should be given that the discharges under the NPDES permit meet water quality standards.* • The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.* • The potential for and effects of DTF failure should be considered.* • The potential for adverse impacts to Sherman Creek from sediment in storm water runoff from borrow pits, personnel camp, snow disposal areas, and diversion ditches should be considered. Riparian areas need to be maintained to minimize sediment input to fresh water. • The potential for reduction in fish habitat due to water withdrawal.	• Habitat integrity • Water withdrawal • Water quality • Sedimentation

*Identified as a significant issue during the scoping process.

Table 4-1. Issues and Indicators by Resource (continued)

Resource	Issue	Indicators
Soils, Vegetation, and Wetlands	• The potential for and effects of DTF failure should be considered.* • The cumulative impacts with other projects in Berners Bay should be considered. • The potential for adverse impacts to Sherman Creek from sediment in storm water runoff from borrow pits, personnel camp, snow disposal areas, and diversion ditches should be considered. Ensure riparian areas are maintained to minimize sediment input to fresh water. • The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.*	• Extent of vegetation disturbed • Net loss of wetlands
Visual Resources	• The visual effects on tourism, especially on cruise ships and ferries, of the proposed changes should be minimized.*	• Compliance and conformance with visual quality objectives
Socioeconomics	• The socioeconomic evaluation of the original FEIS should be updated. • The cumulative impacts with other projects in Berners Bay should be considered.	• Changes in population, employment, housing, health and social services, public safety, public utilities, revenues, and expenditures
Transportation	• The impacts from spills caused by transporting, storing, and handling additional diesel fuel could affect water quality, fisheries, and other resources.* • The cumulative impacts with other projects in Berners Bay should be considered.	• Risk and consequences of accidents and spills

*Identified as a significant issue during the scoping process.

4.1 AIR QUALITY

This section discusses the potential impacts of atmospheric emissions from the four project alternatives on air quality and visibility. Section 4.10 discusses the potential impacts to visual resources from other sources. Specifically, this section explains air pollutant sources and activities associated with each alternative and quantifies the expected emission rates for air pollutants. The potential environmental impacts caused by each alternative are discussed according to the following indicators:

- Emissions and compliance with State and Federal standards, as well as compliance with prevention of significant deterioration (PSD) increments
- Visual impacts associated with emissions.

4.1.1 Effects of Alternative A (No Action)

Emissions and PSD Increments

This section discusses the potential impacts from emissions, including carbon dioxide, as well as relevant PSD increments, during construction and production activities.

Construction Activity

The potential impacts to air quality are discussed on pages 4-1 through 4-9 of the FEIS.

Production Activity

Pollutant emissions during the operational phase of the Kensington Gold Project would be greater than during construction. During operation, primary pollutant emission sources associated with Alternative A would include the following:

- Mining sources (emissions from underground operations and ore handling and storage)
- Access road (vehicle emissions and dust)
- Tailings structure (dust from wind erosion)
- Powerplant (emissions from liquefied petroleum gas [LPG] turbines or diesel generators).

This section discusses analyses conducted to estimate anticipated air quality impacts. This section also describes other factors, including proximity of public access, source configuration, and meteorology, that could affect the expected ambient pollutant concentrations. Pollutant emission rates were computed using standard equations (TRC, 1995; TRC, 1990). Total suspended particulate (TSP) emissions from the tailings facility were calculated from the structures at maximum size.

A complete inventory was calculated for all emission sources from Alternative A. The primary pollutants from the emission inventory are oxides of nitrogen (NO_X), sulfur dioxide (SO_2), and particulate matter (PM_{10}), with smaller amounts of carbon monoxide (CO) and volatile organic carbons (VOC). Table 4-2 presents emissions predicted for Alternative A.

EPA and Alaska Department of Environmental Conservation (ADEC) policy require Alaska ambient air standards and PSD increments to be met at the property boundary of the facility. Ambient air quality impacts for Alternative A were calculated using EPA's COMPLEX1 and Industrial Source Complex models. Modeling for this alternative was performed for the original air quality permit (TRC, 1991). Background concentrations were added to the modeled concentrations to obtain the ambient air quality impact from the facility. This impact was compared to EPA and ADEC ambient air quality standards. Table 4-3 provides the calculated impacts from Alternative A and the corresponding Federal and State standards for each pollutant. As shown, no modeled pollutant concentration is greater than the Federal or State standards for ambient air quality.

EPA and the State of Alaska PSD guidelines do not consider the Kensington Gold Project to be a major facility and, therefore, a PSD analysis is not required. For informational purposes, a PSD increment was added to the Draft SEIS to show that no significant impacts are expected from the mining operation. Table 4-4 presents the results of this analysis. Because incremental analyses are only performed on pollutants with stack emissions greater than 40 tons per year,

Table 4-2. Predicted Emissions (production phase) From Alternative A (tons/year)

Emission Type	TSP	PM_{10}	NO_X	SO_2	CO	VOC	Pb
Point	1.58	1.09	138.85	0.22	47.48	6.77	8.15e-06
Fugitive	31.72	22.51	76.61	12.06	64.74	7.26	2.16e-05
Total	33.30	23.60	215.46	12.28	112.22	14.03	2.98e-05

Table 4-3. Comparison of Modeled Pollutant Concentrations (production phase) With Ambient Air Quality Standards (including background) for Alternative A

Pollutant	Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$)	EPA Standard ($\mu g/m^3$)*
Nitrogen Dioxide	Annual	12.4	100
Carbon Monoxide	1-hour	2544.2	40,000
	8-hour	394.8	10,000
Particulate Matter	24-hour	57.7	150
	Annual	25.2	50
Sulfur Dioxide	3-hour	156.8	1,300
	24-hour	24.5	365
	Annual	1.5	80

*EPA standards are the same as ADEC standards.

Table 4-4. Comparison of Modeled Pollutant Concentrations (production phase) With PSD Class II Increments for Alternative A

Pollutant	Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$)	PSD Increment ($\mu g/m^3$)
Nitrogen Dioxide	Annual	8.4	25
Sulfur Dioxide	3-hour	156.8	512
	24-hour	24.5	91
	Annual	1.5	20

only nitrogen dioxide (NO_2) and SO_2 were modeled. The values for this analysis are taken from Table 3 of the executive summary of the *Project Report: Air Quality Permit Modification, Kensington Project* (TRC, 1995). All predicted concentrations are well below the PSD increment levels for all modeled pollutants.

All fossil fuel-burning equipment has large emissions of carbon dioxide. Most of the carbon dioxide produced by the Kensington Gold Project under all alternatives would result from the power generation units. Alternative electrical generation systems, including hydroelectric, nuclear, and solar power, do not burn fossil fuel. For the small scale and location of the Kensington Gold, none of these alternatives is feasible.

Carbon dioxide emissions from power generation for all alternatives were estimated using EPA-published emission factors (EPA, 1995). Alternative A would use five 3.5-megawatt (MW) LPG turbines to produce the electricity for the mine (only three would run simultaneously). Alternative A would produce hourly and annual carbon dioxide emissions of approximately 6

and 55,000 tons, respectively. Under Alternative A, the operator would be required to develop and implement an energy efficiency program to minimize electricity generation needs.

Visual Quality

Modeling was not performed to evaluate the potential effects that emissions would have on visual quality under Alternative A. Modeling was conducted for Alternative B, however, which is the worst-case scenario for emissions across all alternatives. Section 4.1.2 discusses the modeling results.

4.1.2 Effects Common to Alternatives B through D

Emissions and PSD Increments

This section discusses the potential impacts from emissions, as well as relevant PSD increments, during construction and operating activities.

Construction Activity

Construction-related pollutant emissions during the pre-production phase for Alternatives B through D would not exceed 9 tons of particulates per year (TRC, 1990). Alternative A is also not expected to exceed this level. The emission levels would essentially be the same for each alternative during the construction period. For every alternative, the total surface area disturbance subject to wind erosion emissions would be approximately 50 acres, and the exposure time would be less than 1 year. Once grading was completed, foundations would be poured and exposed areas stabilized.

Diesel generators would be used as a temporary power supply during the construction phase of the operation. Modeling indicates that National Ambient Air Quality Standards would not be exceeded in the area around the project boundary (Richins, 1991). As shown in Table 4-5, applicable PSD increments would not be exceeded.

Slash burning during the construction phase would cause smoke emissions. The burning would be limited to the construction months and would be confined to small, controlled areas to ensure fire safety. Slash burning would have to comply with open burning regulations imposed by ADEC to reduce airborne pollutants.

Table 4-5. Comparison of Modeled Pollutant Concentrations (construction activity) With PSD Class II Increments for Alternatives B Through D

Pollutant	Averaging Period	Maximum Predicted Concentration (μg/m^3)	PSD Increment (μg/m^3)
Nitrogen Dioxide	Annual	11.8	25
Sulfur Dioxide	3-hour	141.4	512
	24-hour	22.5	91
	Annual	1.1	20

Production Activity

The pollutant emissions during the operational phase of the Kensington Gold Project would be greater than during construction. During operation, primary pollutant emission sources common to Alternatives B through D would include the following:

- Mining sources (emissions from underground operations and ore handling and storage)
- Haul road (vehicle, including haul truck, emissions and dust)
- Tailings structure (dust from wind erosion)
- Powerplant (emissions from LPG turbines or diesel generators).

Sections 4.1.3 through 4.1.5 discuss the analyses, except for carbon dioxide, used to estimate the anticipated air quality impacts for Alternatives B through D, respectively. The sections also describe other factors, including proximity of public access, source configuration, and meteorology, that could affect the expected ambient pollutant concentrations. Pollutant emission rates were computed using standard equations (TRC, 1995; TRC, 1990). TSP emissions from the tailings facility were calculated from the structures at maximum size.

Alternatives B through D would use three 3.3-MW diesel generators. Alternatives B through D each would require a total electricity load estimated at 68,400,000 kilowatt (kW) per hour per year (Coeur, 1995). Using EPA-published emissions factors (EPA, 1995), Alternatives B through D would produce hourly and annual carbon dioxide emissions of approximately 8 and 67,000 tons, respectively. Similar to Alternative A, the operator would be required under Alternatives B through D to develop and implement an energy efficiency program to minimize electricity generation needs.

Visual Quality

The potential impacts that emissions would have on visual quality were modeled using the worst-case scenario, Alternative B.

Air pollutant emissions can impair visibility and obscure visually significant features and areas from viewers. Tour ships using Lynn Canal have views of unbroken shorelines, backed by forested foothills and steep, rocky, and snow-capped peaks. Emissions of nitrogen oxides and particulate matter could reduce visual site distances due to light scattering from pollutants in an emitted plume. The screening model VISCREEN was used to determine whether emissions of NO_2 and particulate matter from activities at the Kensington Gold Project would impair visibility from Lynn Canal.

VISCREEN is designed to calculate visual effects parameters for a plume as observed from a given vantage point. The calculated parameters are then compared to screening criteria. This model is a conservative screening tool used by EPA in determining adverse visual impacts to Class I areas.

Class I areas are areas required by EPA and States to remain in a pristine and unspoiled state. Examples of Class I areas include some designated national parks and wilderness areas. Very rigid requirements are imposed on facilities that operate near Class I areas. The nearest Class I area to the Kensington Gold Project is Denali National Park. The Class I requirements were used to show that emissions from the mine and its facilities would have very little visual impact on the surrounding area.

VISCREEN was used to show the visual effects of emissions from the operation of the mine. The screening modeling was specifically applied to study visual impacts of the mine on views of the shoreline from tour ships. The observer in the modeling scenario was placed in the center of Lynn Canal looking toward the shore and the Kensington site. Point emissions of NO_X and particulate matter were modeled using stable Class F meteorological conditions with an average windspeed of 1.93 meters per second. The meteorological conditions were taken from the air quality permit modification. Table 4-6 presents the parameters used for the modeling.

The VISCREEN results show no significant deterioration of visual quality when looking from Lynn Canal toward the mine. Table 4-7 provides the maximum visual impacts and the corresponding Class I screening criteria. Comparison of the predicted impacts with the Forest Service visual quality objectives (VQOs) (Chapter 3) indicates that these impacts would be consistent with the objectives. Using default worst-case assumptions, the model predicted a slight impact from some plume visibility. Any visual impacts would be mitigated by the climactic conditions (e.g., wind, fog) in the area. The plume would be comparable to a plume generated by the diesel-powered generating backup facility in Juneau, as well as by a cruise vessel traveling along Lynn Canal. The plume would also be similar to the plume from the LPG-fired generators under Alternative A.

Table 4-6. Input Parameters to the VISCREEN Model

Parameter	Value
NO_X Emissions (tpy)	220.58
Particulate Emissions (tpy)	32.02
Background Visual Range (km)	40
Source-Observer Distance (km)	9.8
Minimum Source Class I Distance (km)	1.8
Maximum Source Class I Distance (km)	9.8
Stability Class	F
Wind Speed (m/sec)	1.93

Table 4-7. Maximum Visual Impacts

	Delta E		Contrast	
Background	Criteria	Plume	Criteria	Plume
Sky	2.00	1.44	0.05	-0.024
Terrain	2.00	1.07	0.05	0.022

4.1.3 Effects of Alternative B (Proposed Action)

Emissions and PSD Increments

Under Alternative B, tailings would be carried by truck to the dry tailings facility (DTF).

Production Activity

Air emissions from Alternative B would be greater than Alternative A for NO_X, SO_2, CO, and PM_{10} primarily because of increased emissions from the powerplant and the increase in fugitive dust emissions from increased borrow, waste rock, and tailings haulage. Table 4-8 presents predicted emissions from Alternative B.

Alternative B was modeled for the Air Quality Permit Modification (TRC, 1996; TRC, 1995). Table 4-9 compares modeled concentrations and pollutant background values with Federal and State ambient air quality standards. Table 4-10 compares modeled concentrations of NO_2, SO_2, and PM_{10} to PSD Class II increment levels. Air quality dispersion modeling shows that the emissions from Alternative B are well below both Federal and State ambient air quality standards and PSD Class II increments.

4.1.4 Effects of Alternative C (Marine Discharge)

The emissions and PSD increments under Alternative C would be the same as those under Alternative B.

Table 4-8. Predicted Emissions (production activity) From Alternative B (tons/year)

Emission Type	TSP	PM_{10}	NO_X	SO_2	CO	VOC	Pb
Point Sources	30.73	29.85	244.82	107.05	37.03	29.45	4.40e-06
Fugitive Sources	128.27	73.25	367.60	36.11	156.88	29.60	3.04e-06
Total	159.00	103.10	612.42	143.16	193.91	59.05	7.44e-06

Table 4-9. Comparison of Modeled Pollutant Concentrations (production activity) With Ambient Air Quality Standards (including background) for Alternative B

Pollutant	Averaging Period	Max. Predicted Concentration ($\mu g/m^3$)	EPA Standard ($\mu g/m^3$)	ADEC Standard ($\mu g/m^3$)
Nitrogen Dioxide	Annual	20.77	100	100
Carbon Monoxide	1-hour	365.17	40,000	40,000
	8-hour	99.15	10,000	10,000
Particulate Matter	24-hour	65.79	150	150
	Annual	25.39	50	50
Sulfur Dioxide	3-hour	325.84	1300	1300
	24-hour	115.22	365	365
	Annual	4.93	80	80

Table 4-10. Comparison of Modeled Pollutant Concentrations (production activity) With PSD Class II Increments for Alternative B

Pollutant	Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$)	PSD Increment ($\mu g/m^3$)
Nitrogen Dioxide	Annual	16.77	25
Sulfur Dioxide	3-hour	153.84	512
	24-hour	42.22	91
	Annual	4.93	20
Particulate Matter	24-hour	25.79	30
	Annual	3.39	17

4.1.5 Effects of Alternative D (Modified DTF Design)

Emissions and PSD Increments

Production Activity

The emissions from Alternative D were not modeled. Predicted emissions from this alternative would be less than from Alternatives B and C due to the reduction of fugitive dust emissions from the road and stack emissions from the haul trucks as a result of the pipeline. Table 4-11 shows the predicted emissions from Alternative D. Tables 4-9 and 4-10, presented previously, show modeled impacts for Alternatives B and C. The potential impacts from Alternative D would be less than the values for Alternatives B and C and, therefore, would be well below both the National Ambient Air Quality Standards and PSD Class II increments.

Table 4-11. Predicted Emissions (production activity) From Alternative D (tons/year)

Emission Type	TSP	PM_{10}	NO_X	SO_2	CO	VOC	Pb
Point Sources	30.59	29.79	244.82	107.05	37.03	29.45	3.00e-06
Fugitive Sources	77.58	50.44	358.87	35.17	154.44	29.20	3.04e-06
Total	108.17	80.23	603.70	142.22	191.47	58.65	6.04e-06

4.1.6 Cumulative Effects

Cumulative air quality impacts would occur if air pollutant emissions from the project were to increase pollutant concentrations at locations affected by other projects (i.e., cumulative effects occur where there is an overlap of air quality impacts).

Air pollutant concentration increases from the Kensington Gold Project would be very localized and confined to the near vicinity of the site. Annual average NO_X concentrations would decrease to below significant levels within 0.6 miles of the process area. Similarly, PM_{10} and SO_2 modeled concentrations are less than 1 $\mu g/m^3$ within 0.6 miles of the project boundary (TRC, 1996; TRC, 1995). Consequently, the cumulative impact on air quality from the Kensington Gold Project and other proposed or suggested projects would be extremely small.

The expected cumulative air quality impact of the Kensington Gold Project at the Greens Creek project, which is located about 45 miles southeast of the Kensington Gold Project, would be immeasurably small. Air quality impacts from the Kensington Gold Project at the Jualin Project site, which is located 2.5 miles southeast from Kensington (and in a different airshed), would be below detectable levels and certainly below applicable ambient air quality standards.

Lace River Hydroelectric has proposed the development of a hydroelectric power generation facility along the Lace River about 10 miles north of Berners Bay. This development could provide additional opportunities for a power source to the Kensington Gold Project. While the Lace River Project could reduce air emissions at the Kensington site, it would require construction and maintenance of transmission lines to the mine, including 5 miles in Berners Bay. Feasibility studies are still underway for the Lace River Project (i.e., no specific proposal has been prepared). If and when a final development plan is proposed to the Federal Energy Regulatory Commission and the operator agrees to purchase power, the effects would be evaluated under the NEPA process for the Lace River Project and/or modifications to the Kensington Gold Project Plan of Operations.

4.1.7 Summary

Tables 4-12 through 4-15 summarize the predicted impacts on air quality under each alternative. Predicted impacts for all alternatives are below Federal and State standards. Table 4-12 summarizes predicted emissions of pollutants from each alternative. Alternative A has the lowest total predicted emissions. Table 4-13 summarizes the predicted impacts of each alternative in comparison to Federal and State standards. None of the projected emissions from any alternative exceeds these standards. Except for CO, Alternative A results in the least impact. Values for Alternatives B through and D are depicted as equal, although Alternative D is expected to produce lower pollutant levels due to decreased vehicle traffic. Table 4-14 summarizes the predicted impacts during the construction phase compared to PSD Class II increments. Pollutant concentrations, which are assumed to be the same for all alternatives during construction, fall below the PSD Class II increments. Table 4-15 summarizes the predicted impacts during construction activity compared to PSD Class II increments. All concentrations fall below the PSD Class II increments. Pollutant concentrations would be the least for Alternative A, except for 3-hour SO_2 concentrations. PM_{10} concentrations were not modeled for Alternative A. Alternatives B through D are depicted as equal, although Alternative D is expected to produce decreased pollutant concentrations due to decreased vehicle traffic.

4.2 GEOTECHNICAL CONSIDERATIONS

4.2.1 Effects Common to All Alternatives

The FEIS presents a geotechnical analysis of all project components under Alternative F, Option 1, including a worst-case scenario for a failure of the tailings dam. This analysis would be the same for all alternatives considered in the Draft SEIS, except for tailings management. This section discusses the risk and potential consequences of a failure from the tailings impoundment (Alternative A) or from the DTF (Alternatives B through D) as an indicator of differences among the alternatives.

Table 4-12. Predicted Emissions by Alternative (tons/year)

	Alternative A			Alternative B			Alternative C			Alternative D		
Source	Point	Fugitive	Total	Point	Fugitive	Total	Point	Fugitive	Total	Point	Fugitive	Total
TSP	1.58	31.72	33.30	30.73	128.27	159.00	30.73	128.27	159.00	30.59	77.58	108.17
PM_{10}	1.09	22.51	23.60	29.85	73.25	103.10	29.85	73.25	103.10	29.79	50.44	80.23
NO_X	138.85	76.61	215.46	244.82	367.60	612.42	244.82	367.60	612.42	244.82	358.87	603.70
SO_2	0.22	12.06	12.28	107.05	36.11	143.16	107.05	36.11	143.16	107.05	35.17	142.22
CO	47.48	64.74	112.22	37.03	156.88	193.91	37.03	156.88	193.91	37.03	154.44	191.47
VOC	6.77	7.26	14.03	29.45	29.60	59.05	29.45	29.60	59.05	29.45	29.20	58.65
Pb	8.15E-06	2.16E-05	2.98E-05	4.40E-06	3.04E-06	7.44E-06	4.40E-06	3.04E-06	7.44E-06	3.00E-06	3.04E-06	6.04E-06

Table 4-13. Comparison of Modeled Pollutant Concentrations (production activity) With Ambient Air Quality Standards (including background) by Alternative[a]

Pollutant	Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$) Alternative A	Alternative B	Alternative C[b]	Alternative D[b]	EPA Standard ($\mu g/m^3$)[c]
NO_2	Annual	12.4	20.8	20.8	20.8	100
CO	1-hour	2,544.2	365.2	365.2	365.2	40,000
	8-hour	394.8	99.2	99.2	99.2	10,000
PM_{10}	24-hour	57.7[d]	65.8	65.8	65.8	150
	Annual	25.2[d]	25.4	25.4	25.4	50
SO_2	3-hour	156.8	325.8	325.8	325.8	1,300
	24-hour	24.5	115.2	115.2	115.2	365
	Annual	1.5	4.9	4.9	4.9	80

a. For comparison to National Ambient Air Quality Standards, background concentrations are included in the results.
b. Values calculated for Alternative B are used for Alternatives C and D, because Alternative C would be the same as Alternative B from an emissions perspective and Alternative D was not modeled and predicted emissions from Alternative D are less than Alternatives B and C.
c. ADEC standards are the same as EPA standards.
d. Values for Alternative A are based on particulate matter rather than PM_{10}.

Table 4-14. Comparison of Modeled Pollutant Concentrations (construction activity) With PSD Class II Increments for All Alternatives

Pollutant	Averaging Period	Max. Predicted Concentration ($\mu g/m^3$) Alternatives A, B, C, D	PSD Increment ($\mu g/m^3$)
NO_2	Annual	11.8	25
SO_2	3-hour	141.4	512
	24-hour	22.5	91
	Annual	1.1	20

Table 4-15. Comparison of Modeled Pollutant Concentrations (production activity) With PSD Class II Increments by Alternative[a]

Pollutant	Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$) Alternative A	Alternative B	Alternative C[b]	Alternative D[b]	PSD Increment ($\mu g/m^3$)
NO_2	Annual	8.36	16.77	16.77	16.77	25
PM_{10}	24-hour	57.7[c]	25.79	25.79	25.79	30
	Annual	25.2[c]	3.39	3.39	3.39	17
SO_2	3-hour	156.8	153.84	153.84	153.84	512
	24-hour	24.5	42.22	42.22	42.22	91
	Annual	1.5	4.93	4.93	4.93	20

a. PSD increments represent the allowable incremental increase in pollutant concentration; they do not include background concentrations.
b. Values calculated for Alternative B are used for Alternatives C and D, because Alternative C would be the same as Alternative B from an emissions perspective and Alternative D was not modeled and predicted emissions from Alternative D are less than Alternatives B and C.
c. Values for Alternative A are based on particulate matter rather than PM_{10}.

4.2.2 Effects of Alternative A (No Action)

Pages 4-9 through 4-13 of the FEIS present a worst-case failure analysis for the Sherman Creek tailings impoundment. This analysis includes two dam failure scenarios: failure under seismic loading and water cutting through the embankment. The FEIS indicates that both types of dam failure are highly unlikely. The FEIS specifically cites centerline construction methods as very stable under high seismic loads. This conclusion is supported by extensive experience with similar types of dams at other mines.

4.2.3 Effects Common to Alternatives B through D

Under Alternatives B through D, tailings would be placed in the DTF in a loose, sandy-silty condition. Because of high precipitation conditions at the project site, portions of the pile could become saturated and not drain. This could lead to a failure of the DTF slopes. The failure could occur during active construction or as a result of an earthquake over the long term. The extent of the environmental consequences associated with a specific failure is difficult to project and would depend on the failure mechanism, location, and magnitude. One worst-case failure scenario would be a flattening of the slope of the fully constructed pile that could reach Lynn Canal and Sherman and Sweeny creeks. The maximum extent of such a failure could cause direct tailings loadings to Sherman and Sweeny creeks, visual impacts in Lynn Canal, loss of wetlands and vegetation, and a long-term source of further tailings loadings to marine and fresh water until mitigation. Another scenario involves a less extensive upgradient slope failure that could affect the performance of the diversion system and lead to greater saturation, as well as ongoing further degradation of the pile.

Sections 4.2.4 through 4.2.6 discuss the potential effects specific to Alternatives B through D, respectively.

4.2.4 Effects of Alternative B (Proposed Action)

Under Alternative B, drainage systems would be installed at the base of and within the DTF. Intermediate barriers and final cover materials would be used to limit infiltration. The basic design does not include any structural controls to enhance stability. The limited area of compaction along the outer shell is intended only to provide a working surface for reclamation. Alternative B provides for construction of a contingency berm in case ongoing monitoring indicated areas of saturation within the DTF. The berm would be similar to that constructed under Alternative D. As discussed in the *Technical Resource Document for Geotechnical Considerations, Kensington Gold Project* (Klohn-Crippen, 1997) the following critical design elements affect whether saturation would occur:

- Maintaining a consistent level of tailings permeability
- Constructing drainage systems that remove excess water from the tailings
- Establishing impervious barriers to limit infiltration of rain and snowmelt.

The overall behavior of the DTF under Alternative B would rely on the performance of all drainage system components, including each of the intermediate drainage and barrier layers, the final cover, and the toe drain. Variability in the performance of any one part of the system/ unit ultimately could affect the stability of other sections of the pile.

The failure scenarios described previously could be caused by saturation of thin zones within the pile (i.e., a small percentage of the total volume of material). Modeling of the performance of the proposed DTF design is based on the assumption that the as-built condition would be the same as the theoretical design condition. Small variability in as-built conditions could result in saturation levels that would affect stability. Some level of variability would be inevitable, especially because of the natural differences in the construction materials, as well as variable construction conditions during the life of the mine. In addition, seismic deformation would result in movements within the pile and additional variability in performance. While the use of dry tailings management has become more widespread worldwide during the past 5 years, there are no case histories for construction of dry facilities of similar design in comparable high precipitation and seismic activity areas. This increases the uncertainty of the modeling results. The Greens Creek Project near Juneau has a DTF. However, Greens Creek uses compaction to achieve geotechnical stability; Alternative B would rely on drainage of the pile to achieve stability. Because of the above uncertainties and lack of proven examples of similar designs, there is a low to moderate risk that the structure could become sufficiently saturated to initiate failure during active operations and post-closure. Monitoring and pre-determined contingencies would reduce this risk during operations. Chapter 2 presents a general monitoring plan, and the *Technical Resource Document for Geotechnical Considerations* (Klohn-Crippen, 1997) describes the detailed geotechnical monitoring program for cell 1 of the DTF. As noted previously, Alternative B provides for contingencies, including an engineered structural berm, if saturation was detected during operation. The *Technical Resource Document for Geotechnical Considerations* (Klohn-Crippen, 1997) provides a detailed description of the predicted geotechnical performance of Alternative B, including potential difficulties and uncertainties.

4.2.5 Effects of Alternative C (Marine Discharge)

The design of the DTF under Alternative C is the same as Alternative B. The risks of saturation and potential failure, therefore, are the same.

4.2.6 Effects of Alternative D (Modified DTF Design)

Alternative D includes the construction of an engineered structural berm around all cells of the DTF prior to tailings placement. Figure 2-4 shows the layout of the berm. Figure 2-11 shows a cross-section of the berm along the western side of the unit. The berm is designed to provide a conservative safety factor for a worst-case condition of saturation of tailings under seismic loading. An even higher safety factor would be provided for saturation under normal operating conditions. Under Alternative D, there is minimal risk of widespread failure of the unit.

4.2.7 Cumulative Effects

Construction of the Jualin Project could have cumulative effects. Construction would require an analysis of the feasibility of tailings management options. Options could include the use of the existing Kensington mill and tailings management facility for wastes from the Jualin Project. Although the design of the DTF does not preclude the use of the facility for disposal of the Jualin tailings, additional studies or design modification could be required depending on the characteristics and volume of materials.

4.2.8 Summary

The risk of a tailings dam failure under Alternative A is very low, based on the performance of similar existing units worldwide. Under Alternatives B through D, the DTF would be designed to avoid tailings saturation within the unit and resulting failure under static and seismic conditions. For Alternatives B and C, there is a low to moderate risk of such saturation occurring, based on uncertainties related to design assumptions and the limited experience using similar designs. Under Alternatives B and C, the risk of failure during operations would be reduced by extensive monitoring and contingencies. Under Alternative D, the DTF would be constructed with an engineered structural berm that would provide structural stability regardless of tailings saturation.

4.3 SURFACE WATER HYDROLOGY

The Kensington Gold Project would affect surface water hydrology and flow regimes in the Sherman Creek watershed and in the small drainage basin located between the lower main channel of Sherman Creek and the lower main channel of Sweeny Creek. Activities that could affect surface water hydrology and processes include development of diversion channels, dams or runoff conveyance structures, and water demand for mining operations. This section assesses the potential impacts on 1) stream flows and flow regimes and 2) the length and location of stream segments as indicators of differences among the alternatives. The potential impacts are discussed in terms of withdrawals or discharges to streams, as well as diversion channels and impoundments.

4.3.1 Effects of Alternative A (No Action)

Water Withdrawals and Discharges

Fresh water for the mill circuit, potable, and other domestic needs would be supplied from a diversion dam on upper Sherman Creek and from mine drainage. Total water supply demands under Alternative A would average 0.42 cubic feet per second (cfs) (190 gallons per minute [gpm]). The location of the diversion dam would be on the stream reach above the confluence with South Fork Sherman Creek below surface water monitoring station 109 (see Figure 3-2, presented in Chapter 3). Figure 2-1, presented in Chapter 2, shows the location of the

proposed dam. The Alaska Department of Natural Resources (ADNR) would permit all water withdrawals.

The catchment area draining to the upper Sherman Creek diversion dam would be approximately 1 square mile (640 acres). Withdrawals would reduce stream flows in Sherman Creek by an average of 0.42 cfs and could affect critical flow requirements in lower Sherman Creek during winter, but this impact would be small. Based on the average monthly flows for lower Sherman Creek (see Table 3-4), a 0.42-cfs withdrawal would result in an average flow reduction ranging from 5 percent in February to 1 percent in June. ADNR would require minimum surface water flows (instream flows) to maintain necessary flows for production of aquatic life, based on recommendations from the Alaska Department of Fish and Game (ADF&G). The operator has proposed the establishment of systems using mine drainage and the development of alternative ground water sources, if required, to supply fresh water to mitigate potential impacts during low flows and maintain minimum flow requirements.

Current mine drainage, estimated to be between 0.2 to 0.8 cfs (100 to 400 gpm), discharges from the 800-foot adit to settling ponds near surface water station 101 (see Figure 3-2). After treatment in the ponds, the drainage is discharged to the south Ophir Creek tributary above the confluence with Ivanhoe Creek. This discharge currently augments flows in Ophir, Ivanhoe, and lower Sherman creeks. Under Alternative A, treated mine drainage would be collected and discharged through the marine outfall. The marine discharge would result in reducing average stream flows in the Ophir/Ivanhoe Creek diversion and in lower Sherman Creek by 0.2 to 0.8 cfs from its current level. Based on average monthly flows (see Table 3-4), the marine discharge of mine drainage would result in a maximum reduction of flow ranging from 10 percent in February to 2 percent in June in lower Sherman Creek.

Diversion Channels and Impoundments

Alternative A would involve approximately 2.1 miles of stream diversion channels. Chapter 2 provides detailed descriptions of diversion channels and runoff control structures. Upper Sherman Creek flows, including flows from South Fork Sherman Creek, would be diverted from the south side of the tailings impoundment via a buried pipeline designed to convey a 25-year, 24-hour storm event. An Ophir Creek diversion would be designed to route the runoff and drainage that would occur from the probable maximum flood (PMF) around the tailings impoundment. The Ophir Creek diversion would be approximately 2,950 feet and return diverted flows to lower Sherman Creek below the impoundment via a concrete spillway (see Figure 2-1).

The diversions would result in the loss and physical destruction of the natural channels in the areas that would be replaced by the diversions. As analyzed in the FEIS, temperature alterations caused by the Ophir Creek diversion would not be significant on lower Sherman Creek. The Ophir Creek spillway would require a design to ensure proper energy dissipation to avoid scouring or alteration of the channel at the point it enters lower Sherman Creek.

The diversions would not be expected to significantly impact the overall flow regimes in the Sherman Creek watershed because they are designed to pass through drainage occurring from

the undisturbed basins above the mine. Impacts to flow velocities and temporal changes in flows would not be expected. High flushing flows that normally occur during spring runoff would not be affected in Ophir Creek as a result of the diversion, because it would be designed to convey the PMF. Flows up to the 25-year, 24-hour event would not be affected by the upper Sherman Creek diversion pipeline.

After mine closure, the Sherman Creek and Ophir Creek diversions would be removed. The channels would be reconstructed and routed through the tailings facility. The channels would be sized to route the PMF flow and engineered to be self-maintaining channels. A program of regular inspection and maintenance of these channels would be required in perpetuity after completion of operations.

The proposed tailings dam and impoundment would be built across the lower Sherman Creek drainage. Discharge from the tailings impoundment under normal operations would be controlled through the outfall according to the National Pollutant Discharge Elimination System (NPDES) permit. As studied in the FEIS, a worst-case scenario for failure of the tailings dam would discharge an estimated peak flow of 17,000 cfs (7.6 million gpm) to the Sherman Creek drainage, thereby removing approximately 215,000 tons of tailings from the impoundment. The flood would also entrain large quantities of soil and rock debris, scouring the existing channel, upper banks, and side slopes. Additional debris loading likely would occur from mass wasting along the side slopes, thereby adding more sediment and debris loads to the flood flow. The FEIS also notes that the likelihood of a failure is very low, based on the design of the unit and the performance of similar existing dams.

The tailings impoundment would capture precipitation that occurs on the impoundment and beach area, as well as contain runoff from the process area. This catchment would be approximately 225 acres. This catchment area would be insignificant to the total area of the watershed, and impounding the storm runoff for this catchment would not significantly impact or reduce flows in lower Sherman Creek. As noted above, excess water in the impoundment would be discharged to Lynn Canal at the NPDES-permitted outfall.

4.3.2 Effects Common to Alternatives B Through D

Water Withdrawals and Discharges

Under Alternatives B through D, the total demand for potable water at the mine, mill, and camp site is estimated at 0.52 cfs (234 gpm). This demand is essentially the same as for Alternative A (0.42 cfs [190 gpm]), and the potential impact on stream flows in lower Sherman Creek would not be significantly different. ADNR would be responsible for permitting all water withdrawals.

An infiltration gallery would be installed upstream of the process area on upper Sherman Creek to collect water for storage in a 300,000-gallon fresh water tank (see Figures 2-2 through 2-4, presented in Chapter 2). In contrast to the diversion proposed under Alternative A, the infiltration gallery would collect water from the stream into a collection gallery while letting a majority of stream flow to pass downstream. Pumping water from the infiltration gallery would

reduce flows temporarily because the gallery would capture water from the creek to replace the amount pumped. During low-flow conditions, pumping from the infiltration gallery might need to be avoided to allow upper Sherman Creek flows to pass to lower Sherman Creek.

Like Alternative A, withdrawals under Alternatives B through D could affect critical flow requirements in Sherman Creek during winter, although impacts would be small. Based on the average monthly flows for lower Sherman Creek (see Table 3-4), this rate of demand would result in a reduction of average flow ranging from 7 percent in February to 1 percent in June. Under Alternatives B and D, this reduction only would occur in upper Sherman Creek between the infiltration gallery and outfall 001 (see Section 4.3.3). As noted for Alternative A, ADNR would impose minimum surface water flow restrictions (instream flows) to protect aquatic life.

Diversion Channels, Runoff and Collection, and Stream Crossings

Alternatives B through D would involve construction of the same storm runoff diversion channels. Channels would be constructed to route and control runoff at the process area in the Sherman Creek drainage and for the DTF in the Terrace Area drainage basin between Sherman and Sweeny creeks. The total length of required stream diversions and catchments would be 12,052 feet (2.3 miles). In addition, five stream crossings would be required by the haul road. An additional storm runoff channel and toe drain totaling 8,481 feet (1.6 miles) would be required around the DTF embankment to collect drainage and provide catchment of runoff from the unit. The *Technical Resource Document for Water Resources* (SAIC, 1997) provides detailed descriptions of the diversion channels, runoff control structures, and stream crossings.

Personnel Camp, Mill Area, and Water Treatment Plant (Mine Process Area)

Alternatives B through D would require two channels to control runoff and route stream flows around the process area in the Sherman Creek basin. The first channel would be a storm water diversion constructed to catch surface runoff from the upper watershed east of the process area. The length of the channel would be 2,992 feet (0.6 mile) and provide drainage for approximately 157 acres (0.2 sq. miles).

The second channel would route Ophir Creek west to Ivanhoe Creek at approximately the 670-foot elevation. The diversion would be 862 feet (0.2 miles) and would be designed to provide drainage from approximately 497 acres (0.8 sq. miles). The diversion would combine with Ivanhoe Creek approximately 2,140 feet (0.4 miles) above the Ivanhoe confluence with Sherman Creek (see Figure 2-2), which is approximately 509 feet (0.1 miles) above its natural confluence. The natural channel could be affected along this 509-foot stream reach during high flows. Impacts could occur because this reach now would be required to convey drainage from both the Ivanhoe and the Ophir creeks sub-basins. The drainage area for Ivanhoe Creek at this location is approximately 418 acres (0.7 sq. miles). The additional drainage area from the Ophir Creek sub-basin would be about 497 acres (0.8 sq. miles), approximately doubling the drainage area. Using information provided from baseline hydrologic modeling (Knight Piesold, 1994), the average annual peak daily flow would increase approximately 41 cfs in this reach. Impacts could include channel down cutting, movement of bed material, and scouring along the sides of the channel. To mitigate potential impacts, the operator has proposed a series of channel

improvements within this reach (SRK, 1996h). Improvements would include removal of existing debris in the channel, stabilization of the creek bed, and channelization or widening of the creek, as required.

Haul roads would require four stream crossings in the process area. One crossing would be a bridge that would replace the current bridge that crosses South Fork Sherman Creek approximately 1,500 feet above the confluence of upper Sherman Creek and lower Sherman Creek. Construction of the bridge would occur above the stream channel, and direct impacts to the creek bed or to flows would not be expected. Appropriate Forest Service BMPs would be applied during construction to minimize erosion and potential impacts.

Two road crossings would be required on upper Sherman Creek, 380 feet and 300 feet along the channel, respectively (see Figures 2-2 through 2-4). In addition, one road crossing 200 feet in stream length would be required on Ivanhoe Creek. These crossings would be constructed using long-span, low-profile arch conduits to route creek flows (SRK, 1996h). These conduits would be designed to maintain natural creek bed conditions and to minimize impacts to the channel that would result from installation. The operator has proposed several measures to minimize impacts during construction, including removal of debris that could impede flows, limited grading and channelization of the creek bed to permit installation, and placement of rip-rap for erosion protection and for improvement of the main flow path to concentrate low flows (SRK, 1996h). Appropriate Forest Service BMPs would be applied during construction to minimize erosion, minimize the number of times equipment crossed the existing creek bed, and limit the area and time of disturbance.

Impacts to lower Sherman Creek are not expected as a result of diversion channels proposed for the process area. Because these channels would be designed to divert natural drainage occurring from the upper Sherman Creek basin, flow regimes within the basin would not be affected significantly. High flows that normally occur during spring runoff would not be affected. These flows would provide velocities necessary to maintain natural channel geomorphologic conditions and flush accumulated sediments that naturally deposit during low-flow conditions. The bridge on South Fork Sherman Creek would be designed at a height to allow flows smaller than the 100-year, 24-hour event to pass below the road. The culvert/conduit crossings would also be designed to pass stream flows below the 100-year, 24-hour event. These culverts would not impact or restrict the stream flows that would result from storms smaller than this design event.

DTF Area

Under Alternatives B through D, two storm water diversion channels would be constructed in the upper watershed east of the DTF facility. The purpose of these diversions would be to prevent drainage generated from unimpacted areas in the watershed from running onto the DTF embankment. The diversions would route flows around the facility to one of the unnamed creeks that flow to Lynn Canal. The first diversion would provide drainage from a 58-acre sub-basin and route flows south and then west around the embankment before converging with an unnamed creek. The length of this diversion is estimated to be 3,678 feet (0.7 miles) (SRK, 1996d). A second diversion would provide drainage from a 90-acre sub-watershed and

route flows north and then west to another unnamed creek. The length of this diversion is estimated to be 4,522 feet (0.9 miles). Section 2.3.5 provides a detailed description of these channels.

An additional storm runoff channel and toe drain totaling 8,481 feet (1.6 miles) would be required around the DTF embankment to collect drainage and provide catchment of runoff from the unit. Runoff and drainage from the DTF would be routed to a sediment detention pond. Section 2.3.5 presents detailed descriptions of DTF diversion channels and the sediment pond.

All the proposed diversion channels would be constructed in an area that currently is drained by a series of small intermittent channels. The construction of these diversions would create channels in areas where channels currently do not exist, thereby disturbing soils and vegetation. Sections 4.7 and 4.8 discuss the potential impacts associated with these resources.

One haul road crossing of an unnamed tributary to lower Sherman Creek would be required below the explosives storage area (see Figures 2-2 through 2-4). This tributary is ephemeral (i.e., only flows as a result of precipitation events). This crossing would consist of several 52-inch diameter culverts placed to route flows and runoff under the road. Appropriate Forest Service construction BMPs would be used during culvert installation to minimize erosion, and installation would not be conducted if the tributary were flowing (SRK, 1996h). Impacts to flows in lower Sherman Creek would not be expected as a result of these culverts because they would be designed to adequately pass flows that could occur in channel.

The diversion channels around the DTF embankment are not expected to affect the overall hydrology of this area. Although the DTF would physically impact several of the small intermittent drainages, the proposed channels would be designed to divert natural drainage occurring from the upper sub-basins. The channels would alter the specific runoff and drainage pattern in the area; however, the natural flow regimes and discharge from the basin would not be affected significantly.

4.3.3 Effects of Alternative B (Proposed Action)

At present, mine drainage augments flows averaging between 0.2 and 0.8 cfs to the south Ophir Creek tributary, Ivanhoe Creek, and lower Sherman Creek. Under Alternative B, mine drainage would be discharged from the process area to the sediment detention pond. After full development, mine drainage is estimated to be between 1.3 cfs to 2.2 cfs (600 to 1,000 gpm). The sediment detention pond would discharge to Sherman Creek approximately 150 feet above the confluence with South Fork Sherman Creek (see Figure 2-2). This scenario would result in reducing average stream flows in Ophir and Ivanhoe creeks by 0.2 to 0.8 cfs from current levels. Discharge to Sherman Creek below the sediment detention pond and above Ivanhoe Creek would be increased by 1.3 cfs to 2.2 cfs (600 to 1,000 gpm). Below Ivanhoe Creek, the net increase would be 1.1 to 1.3 cfs (500 to 600 gpm). Based on average monthly flows (see Table 3-4), the net increase would result in a maximum flow augmentation ranging from 15 percent in February to 3 percent in June in lower Sherman Creek. This flow augmentation is not a significant

increase compared to peak flows expected from storm events, and impacts to the stream channel are not expected.

4.3.4 Effects of Alternative C (Marine Discharge)

As indicated previously, mine water discharge currently augments flows averaging between 0.2 and 0.8 cfs to Ophir, Ivanhoe, and lower Sherman creeks. Under Alternative C, treated mine drainage would be collected and discharged through the marine outfall. The potential impact to stream flows would be similar to those discussed for Alternative A, reducing average stream flows in Ophir and Ivanhoe creeks by 0.2 to 0.8 cfs from current levels. This reduction also would occur in lower Sherman Creek, because mine drainage would be routed to the marine outfall. Based on average monthly flows (see Table 3-4), the marine discharge of mine drainage would result in a maximum reduction of flow ranging from 10 percent in February to 2 percent in June in Sherman Creek.

4.3.5 Effects of Alternative D (Modified DTF Design)

Under Alternative D, mine drainage management would be similar to Alternative B, discussed in Section 4.3.3. In addition, a pipeline would be constructed to slurry tailings from the mill to a dewatering facility near the DTF. An additional pipeline would be used to return reclaimed water back to the mill for reuse. Because water would still be recycled for use in the mill, this alternative would not result in additional water demands or water withdrawals or effects to basin hydrology beyond those for Alternative B. The potential impacts to surface hydrology specific to Alternative D, therefore, are essentially the same as those as described in Sections 4.3.2 and 4.3.3.

4.3.6 Cumulative Effects

The potential impacts to hydrology and watershed processes as a result of the Kensington Gold Project would be limited to the Sherman Creek watershed and the small drainage basin located between the lower main channel of Sherman Creek and the lower main channel of Sweeny Creek. Creeks within these basins drain to Lynn Canal. If developed, the Jualin Project would be located within the Johnson Creek watershed east of the Sherman Creek watershed. Johnson Creek drains to Berners Bay. Because these projects would be located in different watersheds, no cumulative impacts to hydrologic processes and water supply are expected as a result of project development.

4.3.7 Summary

Table 4-16 provides a summary matrix of the potential hydrologic impacts and descriptions for all alternatives. Water demand for all alternatives is approximately the same. Estimates for Alternative A are slightly lower (190 gpm) than for the other alternatives (234

Table 4-16. Summary of Hydrologic Impacts by Alternative

Alternative	Water Withdrawals		Stream Flow	Other
A (No Action)	190 gpm (0.42 cfs)	Impoundment on upper Sherman Creek	Potential impact to instream flows during winter low-flow periods. Marine discharge of mine drainage reducing average stream flow 0.8 cfs in lower Sherman Creek.	Tailings dam and impoundment; 225-acre catchment; dam failure would release 17,000 cfs to lower Sherman Creek
B (Proposed Action)	234 gpm (0.52 cfs)	Infiltration gallery on upper Sherman Creek	Potential impact to instream flows during winter low-flow periods. Discharge of mine drainage to Sherman Creek increasing average stream flow 1.3 cfs.	DTF with drainage catchment totaling 1.6 miles
C (Marine Discharge)	234 gpm (0.52 cfs)	Infiltration gallery on upper Sherman Creek	Potential impact to instream flows during winter low-flow periods. Marine discharge of mine drainage reducing average stream flow 0.8 cfs in Sherman Creek.	DTF with drainage catchment totaling 1.6 miles
D (Modified DTF Design)	234 gpm (0.52 cfs)	Infiltration gallery on upper Sherman Creek	Potential impact to instream flows during winter low-flow periods. Discharge of mine drainage to Sherman Creek increasing average stream flow 1.3 cfs.	DTF with drainage catchment totaling 1.6 miles

gpm). This difference is insignificant, constituting only 0.1 cfs in stream flow and water withdrawal from Sherman Creek. For 234 gpm (0.52 cfs), the rate of demand would result in a reduction of average flow that ranges from 7 percent in February to 1 percent in June in lower Sherman Creek.

Alternative A would require two main diversions to divert flows from the upper watershed around the process area and tailings impoundment. The total length of these diversions would be 2.1 miles.

Alternatives B through D would require four main diversions totaling 2.3 miles. One stream diversion would be required to divert Ophir Creek away from the process area, and a second one would provide catchment for runoff from the watershed above the process area. In addition, these alternatives would require two additional diversions to provide catchment of runoff from the watershed above the DTF embankment. Alternatives B through D would also require 1.6 miles of additional channel catchments and a toe drain to capture drainage and runoff from the DTF embankment.

Natural hydrologic flow regimes would not be disrupted significantly by any alternative. The potential impacts of water withdrawals on instream flow requirements during low-flow periods are common to all alternatives. All alternatives could require mitigation through the use of alternative ground water sources during low-flow periods, if compliance with instream flow requirements was necessary. The Ophir Creek diversion proposed under Alternatives B through D would increase average monthly discharge by 41 cfs in a 509-foot stream reach of Ivanhoe Creek. The channel in this reach would be improved to mitigate potential impacts from increased flows. This increased discharge could cause scouring and bedload erosion of the

channel in this reach. Restoration of the stream channel could be required after cessation of mine operations.

The marine discharge of mine water under Alternatives A and C would reduce average stream flows in Ophir and Ivanhoe creeks by 0.2 to 0.8 cfs from current levels. Under Alternatives B and D, mine water would be discharged to lower Sherman Creek, increasing average stream flows by 1.1 to 1.3 cfs and reducing average stream flows in Ophir and Ivanhoe creeks by 0.2 to 0.8 cfs. These withdrawals and discharges would not be expected to significantly impact stream flows in these streams.

Under Alternative A, an unlikely failure of the tailings dam would heavily impact lower Sherman Creek. The DTF, proposed under Alternatives B through D, would physically destroy several small intermittent drainages within its proposed footprint.

4.4 SURFACE WATER QUALITY

This section discusses the potential impacts of the four project alternatives on local surface water quality (fresh water). Activities or sources that could affect surface water quality include mine drainage and discharge; tailings disposal: accidental spills; development of sand, gravel, and till source areas and roads; and other construction activities. The potential environmental impacts caused by each alternative are discussed using three indicators: sedimentation, effluent quality, and accidental spills.

4.4.1 Effects of Alternative A (No Action)

Sedimentation

Under Alternative A, the potential for sediment loading to Sherman Creek and other area streams within the watershed would be highest during construction. Sediment loading would be greatest during initial construction activities at the process area, the tailings facility, and the marine terminal and would decrease as operations stabilize and approach baseline conditions.

Actual erosion and sediment loadings to streams depend greatly on specific weather patterns and storm events, as well as on the effectiveness of applied Forest Service BMPs to control erosion. Storms producing high rates and volumes of rainfall have the potential to produce relatively higher volumes of runoff with more energy to entrain sediments in disturbed areas. Erosion and sediment loadings are expected to be relatively higher during high-intensity rainfall events or rainfall events producing high volumes of runoff.

Initial construction under Alternative A would include roads, camp and mill facilities, a water treatment plant, a water supply diversion and storage impoundment on upper Sherman Creek, diversion channels around the tailings impoundment, drainage and sediment control structures, and temporary waste rock storage. A total of 282 acres would be disturbed.

For all alternatives, appropriate BMPs as required by the Forest Service or the appropriate cooperating agency would be employed to control erosion and sediment loadings to streams. Mulching and revegetation would be used on disturbed areas. Travel areas would be graveled. Sediment from areas affected by construction would be controlled by straw bale barriers, grass filter waterways, and sediment collection traps in roadside ditches. Concentrated runoff from surface drainages would be routed through sediment detention basins. Runoff from the mine and mill site area and waste rock storage would be routed to the tailings pond, settled, and discharged to Lynn Canal.

The final Plan of Operations would include a series of Forest Service required BMPs (USFS, 1996b) that would be applied during construction and operations to address erosion control, protection of riparian areas and streambanks, and construction issues. These BMPs would address roads, quarries, and borrow pits; snow removal; and site access and closure. As discussed on page 4-18 of the FEIS, the sediment and nonpoint source water pollution control measures should be adequate to protect the local surface water resources from potential degradation of water quality from sediment loadings.

Effluent Quality

Under Alternative A, process wastewater would be managed in a tailings impoundment and discharged through a marine outfall. The water quality of Sherman Creek would not be affected by effluent discharges during normal operation. The primary pathway for potential contamination of local surface water from tailings effluent would be seepage from, or failure of, the tailings dam or leakage or rupture of the effluent pipeline. The tailings impoundment would be designed with a seepage collection pond below the dam. Seepage would be pumped from the pond back to the impoundment. Therefore, the potential for significant volumes of seepage bypassing the pond and discharging to Sherman Creek is low. If seepage was discharged, however, the characteristics would be the same as those of the tailings effluent. Section 4.6 discusses the characteristics of the projected marine discharge of tailings.

Accidental Spills

Section 4.13 provides a detailed discussion of the expected volume and frequency of transportation traffic and the probability of spills for both diesel fuel trucks and cyanide transport trucks. Section 4.6 discusses the potential impacts of spills on fisheries.

Accidental spills of tailings effluent could occur through rupture of the discharge pipeline or failure of the dam. The probability of effluent pipeline failure is assumed to be similar to a diesel pipeline (i.e., 0.89 failures per thousand miles per year). For the approximate 1.6 miles of effluent pipeline that parallel Sherman Creek, this would represent a probability of 0.0014 spills per year (1.4 in 1,000). The composition of such discharges would be the same as the projected marine discharge characteristics.

4.4.2 Effects Common to Alternatives B Through D

Sedimentation

Under Alternatives B through D, sediment would be controlled primarily through the use of sediment detention ponds. Ponds would be used to minimize erosion and sedimentation from three areas: 1) personnel camp, mill area, and water treatment plant, 2) till borrow area, and 3) DTF. As discussed under Alternative A, the potential for erosion and sediment loadings below project disturbance areas would be highest during construction activities. Erosion and sediment loadings would be expected to be higher during high-intensity rainfall events or rainfall events producing high volumes of runoff.

The construction of the following primary areas would have the potential to generate sediment and cause sedimentation in streams:

- Personnel camp, mill facilities, and water treatment plant
- Till borrow area
- Haul roads
- DTF embankment.

The minimum disturbed area under Alternatives B through D would be 250 acres. Sections 4.4.3 through 4.4.5 present the potential acreage disturbed for Alternatives B through D, respectively. For all alternatives, BMPs would be employed to minimize and control sediment loading to area streams. Mitigation measures would include mulching and revegetating disturbed areas, graveling traffic areas with crushed borrow rock, and using straw bale barriers, grass filter waterways, filter fabric, and sediment collection traps as needed to protect erosive areas affected by construction. Sediment detention basins would be used to remove sediment prior to discharge to streams or wetlands. This section analyzes the potential for sedimentation during the construction of the areas listed previously and describes BMPs for controlling sediments.

Personnel Camp, Mill Area, and Water Treatment Plant

A sediment detention pond would be constructed to control storm runoff and mitigate potential impacts from sediment erosion from the personnel camp, mill area, process area, vehicle washing area, sand and gravel borrow area, and mine drainage treatment plant. The *Technical Resource Document for Water Resources, Kensington Gold Project* (SAIC, 1997) describes the design of the sediment detention basin. Traffic areas would be covered with crushed gravel from the borrow area to minimize erosion. The sand and gravel borrow area would be constructed to minimize soil erosion from cut slopes and exposed surfaces during construction according to BMPs established by the Forest Service. Silt fences, straw bale barriers, and slash windrows would be used in the borrow area as required.

Under the NPDES permit, effluent from the process area pond could not exceed the total suspended solid (TSS) daily maximum level of 30 mg/l and monthly average of 20 mg/l. This would be accomplished by using BMPs throughout the catchment area and enhanced settling within the pond. The mine drainage treatment system would include both underground settling

and surface filtration, which would ensure compliance of TSS levels in the mine drainage with effluent limits. Sediment loadings from the pond that meet these limits are not expected to significantly impact Sherman Creek. It is anticipated that the finer (non-settleable) sediments that could be released would remain entrained by normal flow velocities in Sherman Creek and be discharged to Lynn Canal. Sections 4.6 and 4.7 provide additional discussion of potential impacts from sediment loadings.

Flocculants would be added to the process area pond to treat flows to meet limits for TSS. Runoff and treated mine drainage from storm events less than the 100-year, 24-hour event would be routed through a pipe to Sherman Creek. Runoff from storms exceeding this event would be routed to Sherman Creek via a spillway, and loading of sediments to lower Sherman Creek could occur. It is anticipated, however, that the potential impacts from these extreme events would be small because the detention pond would still settle a majority of eroded sediments and control high-velocity flood flows to the channel. In addition, modeling suggests that finer (non-settleable) sediments that could be released during high flows would remain suspended by the normal flow velocities in Sherman Creek (SRK, 1996g). These suspended solids would be transported to Lynn Canal. This would limit the potential impacts to spawning gravels and the benthic environment from fine sediments. Section 4.6 presents additional discussion regarding potential impacts of sediment loadings to Lynn Canal.

Haul Roads

The existing road at the project site would be upgraded and relocated to support construction of the DTF, subsequent mining, and ore-processing activities (see Figures 2-2 through 2-4, presented in Chapter 2). The road would be widened to a 60-foot running width with turnouts as needed for safety, thus increasing the potential for erosion and sedimentation. Additional ancillary roads would be constructed to access other facilities, including the explosives storage area, the infiltration gallery, laydown areas, the camp, and borrow sites. Stream crossings, described in Section 4.3.2, would be required on an ephemeral creek below the explosives storage area (one crossing), on South Fork Sherman Creek (one crossing), on upper Sherman Creek (two crossings), and on Ivanhoe Creek (one crossing) (see Figures 2-2 through 2-4).

Runoff and potential erosion from the roads would consist of nondiscrete overland flows. Ditches would be constructed along the length of all roads with cross culverts installed to supply local drainage. Appropriate Forest Service BMPs (e.g., straw bale barriers, filter fabric, and sediment collection traps) would be applied to control sediments along the storm ditches. Storm runoff and eroded sediment from the roads would be monitored at various sampling locations according to NPDES permit provisions and discharged to wetland areas at NPDES-permitted outfalls. The NPDES permit would require the operator to develop and implement a storm water pollution prevention plan (SWPPP), including BMPs, for haul road discharges. With appropriate design and maintenance of BMPs, as required by the Forest Service and incorporated in the SWPPP, these discharges are not expected to cause significant impacts to wetland areas and are not expected to affect area streams.

Forest Service BMPs would specifically be applied to minimize erosion during construction of stream crossings. These BMPs would include minimizing the number of times equipment crosses the creek bed, limiting the area of impact, and minimizing the time of disturbance. Stream crossing construction also would be avoided during critical periods for anadromous fish. The Forest Service and ADF&G would coordinate in defining these periods.

Till Borrow Area

Erosion could occur from the till borrow area. The borrow area would be constructed to minimize soil erosion from cut slopes and exposed surfaces during construction using appropriate BMPs established by the Forest Service. Interim drainage within the borrow area would include the use of silt fences, straw bale barriers, and slash windrows, as required. Storm runoff from this area would be collected and routed to a sediment pond for settling and infiltration into coarse materials. Discharge from this pond would only occur during storm events exceeding the 100-year, 24-hour event via a spillway. If required, the discharge would be routed to a wetland area north of Sherman Creek (see Figures 2-2 through 2-4) and, if required, flocculants would be added to enhance settling prior to discharge. This discharge also would be addressed by the NPDES permit and SWPPP, including monitoring requirements and BMPs. Potential discharges are not expected to significantly impact wetlands or affect area streams.

DTF Embankment

Potential sources of runoff associated with the DTF embankment include reclaimed areas, placed waste rock, and tailings, as well as stockpiles of waste rock and soil, depending on the construction stage of the DTF. The catchment area for runoff and the proportion of reclaimed versus active placement areas would change throughout the period of operation. The maximum catchment area and, therefore, the worst-case scenario for runoff and sedimentation, is estimated to be 92 acres during a period near the later stages of the mine operation.

A sediment detention pond would be constructed to control storm runoff and erosion of sediments from all disturbed areas at the DTF site. The *Technical Resource Document for Water Resources, Kensington Gold Project* (SAIC, 1997) provides a detailed description of the design of the sediment detention basin. Runoff from storms exceeding the 100-year, 24-hour storm event would be routed to Unnamed Creek over a spillway. Similar to the process area pond, the NPDES permit would require that effluent from the DTF pond meet the TSS daily maximum level of 30 mg/l and monthly average of 20 mg/l. This would be accomplished through the use of BMPs at the DTF site and enhanced settling within the pond. Flocculants would be added to the pond to ensure compliance with effluent limits. Sediment loadings from the pond in accordance with these limits are not expected to significantly impact Unnamed Creek below the DTF. It is anticipated that the finer (non-settleable) sediments that could be released during high flows would remain entrained by the normal flow velocities in the channel (SRK, 1996g). Potential sediment loadings to Unnamed Creek could occur from extreme events larger than this event. Observations have noted that surface water flows from this channel do not outfall to Lynn Canal, but terminate at Comet Beach. These observations indicate that sediments would not be discharged to Lynn Canal. Section 4.7 provides additional discussion on the potential effects of sediment loadings on aquatic life.

Effluent Quality

Under Alternatives B through D, ore processing would remove most of the potentially acid-generating sulfide materials. The sulfide concentrate would be sent offsite for further processing. Therefore, the flotation tailings are not expected to generate acid. To support this conclusion, the operator conducted total sulfur and acid generation potential testing of flotation tailings produced by two pilot-scale milling process runs in 1996. The flotation tailings from the two runs had sulfide concentrations of 0.027 and 0.04 percent (see Appendix D). The neutralization potential to maximum potential acidity (NP:MPA) of a flotation tailings sample was 166:1. Ratios of 3:1 or less generally are considered as having the potential to generate acid.

Under normal operating conditions, the discharge point for mine drainage and DTF effluent would vary depending on the alternative. Therefore, Sections 4.4.3 through 4.4.5 describe pollutant loadings to Sherman and Unnamed creeks under normal operating conditions from flows less than the 100-year, 24-hour storm event under Alternatives B through D, respectively.

Accidental Spills

Sections 4.4.3 through 4.4.5 discuss the potential impacts to surface water resources that could result from accidental spills or traffic accidents under Alternatives B through D, respectively.

4.4.3 Effects of Alternative B (Proposed Action)

Sedimentation

Alternative B would disturb a total of 250 acres, which is the minimum amount of estimated total disturbed area for any alternative. The major areas disturbed and the potential for impacts from erosion and sedimentation to streams are the same as those described for Alternatives B through D in Section 4.4.2. The small differences in acreage to be disturbed between Alternative B and the other alternatives are primarily because pipelines would not be used under Alternative B to transport fuel, tailings, or treated effluent between the mine process area and the DTF area or the marine terminal. Overall, the potential for impacts to Sherman Creek or the unnamed creeks draining the area of the proposed DTF from erosion and sedimentation are low because BMPs would be applied to minimize potential impacts.

Effluent Quality

Treated Mine Water Effluent

Treated mine water would be routed through a pipe and discharged into a sediment pond designed to control runoff from the process area. The flow rate from the sediment pond would vary, depending on the volume of discharge from various storm events and the quantity of discharge from the mine water treatment plant. The rate of discharge from the treatment plant

would vary with mine dewatering rates, which are estimated to range between 600 and 1,000 gpm, during active operations (SRK, 1996d).

Mine water would be discharged to Sherman Creek at outfall 001. Impacts to Sherman Creek are not expected as a result of the discharge of the treated mine water. Table 4-17 provides the projected discharge characteristics and water quality-based NPDES permit limits for fresh water discharges from the process area pond. The water quality criteria for several metals are based on hardness (i.e., the toxicity of the metal to aquatic life depends on the hardness of the water). The NPDES permit limits would provide for "tiered" limits, thereby allowing the operator to determine the applicable limit based on the instream hardness at the time of sampling. There is no evidence to suggest that the variability in hardness itself could affect aquatic life. The untreated mine water quality is based on statistical analysis of the monitoring data for existing station 101, the current mine drainage discharge point. The *Technical Resource Document for Water Resources* (SAIC, 1997) presents the complete results of and assumptions for the statistical analysis.

As indicated in Table 4-17, the treatment plant could be operated to achieve compliance with all indicated discharge limits. The treatment technology proposed (i.e., precipitation and settling followed by filtration) would remove virtually all metals present as insoluble species. Thus, the effluent characteristics shown are based on the soluble concentrations detected in the station 101 discharge (Montgomery Watson, 1996a). The projected levels of treated mine drainage are conservative in that most soluble metals concentrations at station 101 were non-detects. In addition, other existing facilities use the same technology to achieve reductions in soluble metals (through adsorption and co-precipitation of soluble species). If operational monitoring indicated that higher than anticipated levels of metals were present in soluble (dissolved) form, some pre-conditioning (e.g., sulfide or borohydride addition) could be used to reduce metal solubility and achieve the discharge concentrations shown.

Ammonia and nitrate previously were detected in the mine drainage at levels above projected permit limits during periods of blasting. In response, a BMP for blasting operations would be required in the NPDES permit that should ensure no further exceedances. The BMP would include the use of insoluble blasting agents and good housekeeping practices. Similar practices have proven successful in limiting ammonia and nitrate concentrations at existing mines.

Alternative B would lead to increased levels of total dissolved solids (TDS) in Sherman Creek and Unnamed Creek through discharges of mine drainage and DTF effluent, respectively. TDS levels in the discharges could approach 1,000 mg/l, based on existing mine drainage discharge data. During low flows, these levels could be observed in the creeks downstream of the discharges. Background TDS concentrations in the creeks are generally less than 100 mg/l.

The State of Alaska has both a human health and an aquatic life water quality standard for TDS that would be applicable to fresh water discharges from the Kensington Gold Project. The human health standard for TDS is 500 mg/l with neither total chlorides nor sulfates exceeding

Table 4-17. NPDES Effluent Limitations Discharge Quality

Parameter	Daily Maximum Limit (Hardness: 50/100/200) (µg/l) [a]	Monthly Average Limit (Hardness: 50/100/200) (µg/l) [b]	Untreated Mine Drainage Station 101, 90th Percentile Conc. (µg/l) [c]	Treated Mine Drainage, Outfall 001 (µg/l)	Projected DTF Area Discharge, Outfall 002 (µg/l) [c]
Arsenic (µg/l)[d]	0.18	0.18	3.2	1.7[e]	2.46
Cadmium (µg/l)	1.08/1.86/3.21	0.54/0.93/1.60	ND (0.2)	ND (0.2)	ND (<3.0)
Chromium (µg/l)	16.0	7.98	ND (10)	ND (10.0)	ND (<20)
Copper (µg/l)	9.22/17.73/34.06	4.60/8.84/16.98	20	3.9[f]	6.92
Lead (µg/l)	2.16/5.23/12.63	1.08/2.61/6.30	3.0	1.0[g]	0.88
Mercury (µg/l)	0.02	0.01	ND (<0.05)	ND (<0.5)	ND (0.2)
Nickel (µg/l)	26.88	13.40	ND (<10)	ND (<10.0)	5.22
Selenium (µg/l)	8.21	4.09	ND (<5)	ND (<5.0)	0.09
Silver (µg/l)	0.20	0.10	0.21	0.10[g]	0.08
Zinc (µg/l)	65.04/77.21/77.21	32.42/38.48/38.48	23	10[g]	32.76
Ammonia, Total (mg/l)	3.45	1.72	<2[h]	<2	1.56
Nitrate (mg/l)	20.0	10.0	<10[i]	<10	4.59
TDS (mg/l)[j]	1,000[g]	1,000[g]	787.0	<800	<1,000[k]
pH (s.u.)[l]	6.5 - 8.5	6.5 - 8.5	6.8 - 8.3	6.8-8.3	6.8-8.3

a. Daily maximum limits would be applied to any one sample.
b. Monthly average limitations would be the mean of the four weekly samples.
c. The levels in parentheses represent the lowest detection limits achieved by the operator using standard EPA methods.
d. The method detection limit for total arsenic is 3.0 µg/l using standard EPA methods for wastewater analysis. The method detection limit is the lowest measurable level at which meaningful data can be obtained. Arsenic concentrations cannot be accurately reported below this limit. In the NPDES permit, therefore, the operator would demonstrate compliance with the arsenic limits by showing that arsenic levels in the discharge were below 3.0 µg/l.
e. Value assumes reduction through treatment due to adsorption and co-precipitation.
f. Based on theoretical hydroxide solubility at pH 8.5.
g. Value assumes removal of the metal through adsorption and/or co-precipitation.
h. Value assumes implementation of an explosives BMP plan.
i. Control of nitrate using an explosives BMP plan should ensure all levels below 10 mg/l.
j. TDS criteria are based on site-specific standard applied for by the operator—pending ADEC rulings.
k. There are no data to specify TDS levels in DTF effluent. However, TDS levels in the DTF are expected to be less than the requested site-specific standard of 1,000 mg/l. As a worst-case scenario, waste rock runoff could have comparable TDS levels to mine drainage—787 mg/l. For tailings seepage, the TDS level in effluent from pilot mill testing conducted by Coeur (1996c) was 810 mg/l. Reclaimed area runoff and coarse till drainage would not be expected to have elevated levels of TDS and should be well below 1,000 mg/l.
l. pH data are the range of values reported to date for station 101. There are no data to describe the pH range for the DTF area discharge. However, because of the relatively inert tailings, waste rock, and coarse till and the contributions from reclaimed area runoff, a pH range comparable to the mine drainage was included in this table. These levels are comparable to pH ranges detected in lower Sherman Creek.
NA = Not Applicable.
ND = Non-Detect.
Source: Coeur, 1996c.

200 mg/l. The aquatic life standard is 1,500 mg/l and, more relevant, less than one-third above background levels. Under Alternatives B and D, these standards could not be met without additional treatment. The operator requested the State to establish site-specific criteria of 1,000 mg/l TDS and 500 mg/l sulfate for Sherman Creek and Unnamed Creek that would receive DTF effluent, as discussed in the following paragraph. The Public Notice for the requested site-specific criteria was published during the week of January 27–31, 1997. EPA's ROD and final NPDES permit cannot be issued for fresh water discharges of wastewater without the site-specific standard or project modifications to reduce TDS levels in the discharges.

Available literature indicates that there are no documented effects on fish or macroinvertebrate populations at TDS levels below 1,500 mg/l. Below 1,500 mg/l, concerns related to variations from background TDS levels are based on observed effects on algae. Such variations can apparently cause undesirable food sources for aquatic life and nuisance plant species. Under Alternative B, discharges from the Kensington Gold Project to fresh water would not cause such effects. This is demonstrated by the existing data and observations at reference locations at the site and downstream of the ongoing mine drainage discharge. The current variability in TDS levels is generally representative of expected variability in TDS levels during operations. During the 10 years of stream monitoring and biological studies completed to date, there have been no observed effects on plant communities from the discharge. To support the request for the site-specific criteria, the operator conducted testing to determine any potential effects on macroinvertebrates from TDS variability. Toxicity tests were performed for TDS levels varying from 0 mg/l to 1,010 mg/l in Sherman Creek water. No toxic effects were observed (EVS, 1997). The *Technical Resource Document for Water Resources* (SAIC, 1997) presents these results. Additional toxicity for fish species is currently underway to further support the site-specific criteria request.

The State drinking water standard for TDS is apparently based on laxative and taste effects (ADEC, 1995). The only scientific reference to TDS-related laxative effects is a 1952 National Research Council study showing that magnesium can cause laxative effects at concentrations of 500 to 1,000 mg/l. Magnesium is not expected to be detected at these levels in discharges from the Kensington Gold Project; existing mine drainage data show all magnesium levels below 54 mg/l. Sodium sulfate and magnesium sulfate cause laxative effects but only at concentrations above 2,000 mg/l. The sulfate and chloride standards of 200 mg/l are based on taste. As noted previously, the site-specific standard request is only for sulfate, not chloride. Chloride levels in existing mine drainage discharge have been consistently below 100 mg/l. There are no scientific references defining the forms of sulfate and levels that cause taste concerns (ADEC, 1995). Many existing water supply systems throughout the United States have sulfate levels well above 200 mg/l. Sulfate levels in the existing mine drainage previously have approached 500 mg/l with no evidence of objectionable taste. In addition, it is unlikely that either Sherman Creek or Unnamed Creek would be used as a drinking water source downstream of the discharges during active operations. The location of the withdrawal for domestic water at the process area is above the discharge point. After mine closure, the discharges would cease, and both TDS and sulfate levels would be expected to return to naturally occurring concentrations.

The potential for long-term generation of acid drainage and associated metals loadings is a concern at many mine sites. Mine drainage data collected for the past 6 years give no indication of potentially acidic conditions (Montgomery Watson, 1996a; Montgomery Watson, 1996b). In addition, the geology of the ore body includes primarily non-acid-generating materials.

As discussed under Section 4.4.2, the treated mine drainage would be combined with runoff from the process area. The principal source of pollutants in this area under normal operating conditions would be the temporary waste rock pile. The waste rock pile would comprise approximately one-third of the drainage area. Runoff from the remainder of the process

area would not be contaminated (i.e., there are no significant sources of pollutants other than TSS). All mill operations would be enclosed, and tailings would be transferred directly from the filters to covered trucks. Assuming that the untreated mine drainage represents the worst-case composition of waste rock pile runoff, the combined waste rock and uncontaminated area runoff would not exceed water quality standards (see the *Technical Resource Document for Water Resources* [SAIC, 1997]). In addition, the operator tested the waste rock for acid generation potential. Acid-base accounting of representative samples of the waste rock showed an NP:MPA of 4.5:1 to 672:1, with most samples having ratios greater than 10:1 (see Appendix D).

DTF Effluent

Effluent from the DTF would be discharged to Unnamed Creek at outfall 002. Modeling was performed to estimate the water quality of effluent that would be expected to be discharged from the DTF sediment detention pond (SRK, 1996d). The model combined leachate or estimated water quality data from all expected sources, including reclaimed area runoff, coarse till drainage, tailings drainage, and waste rock runoff, with anticipated flows (SRK, 1996c). Reclaimed area runoff is expected to be uncontaminated and has been characterized using data collected for ephemeral drainages in the vicinity of the DTF. Coarse till drainage characteristics were projected based on coarse till leachate analyses. Tailings drainage could represent either residual moisture from the milling process or infiltration through the pile. Tailings drainage was characterized using mill water produced during a 1996 pilot test by the operator and flotation tailings leachate analyses (Coeur, 1996c). The highest values for each parameter from these tests were included in the effluent characterization. As discussed previously, existing mine drainage is assumed to be the worst-case composition of waste rock runoff. Table 4-18 summarizes estimates of flow rates occurring from each source. These flows would vary depending on actual precipitation events and monthly and annual variations in precipitation. Table 4-17, presented previously, provides the worst-case scenario for water quality discharges from the DTF. All concentrations are below the applicable water quality-based limits except for monthly average copper and zinc concentrations at a hardness of 50 mg/1. Downstream hardness typically would exceed 200 mg/1, and the higher limits based on elevated hardness would apply. Low residual ammonia and nitrate levels in the discharge would be ensured by the blasting BMP required by the NPDES permit.

As noted previously, the existing data indicate that the projected discharge quality at outfall 002 would meet water quality-based NPDES permit limits. The discharge would be monitored under the NPDES permit to ensure compliance with these limits. If pollutant levels

Table 4-18. Estimated Average Discharges From DTF Embankment

Contributing Source	Anticipated Quarterly Flows (gpm)				
	Jan, Feb, Mar	Apr, May, Jun	Jul, Aug, Sep	Oct, Nov, Dec	Annual
Waste Rock Runoff	91.7	45.3	93.7	213.0	111
Tailings Drainage	2.9	5.0	5.0	8.4	5
Coarse Till Drainage	28.8	6.7	27.8	156.0	55
Reclaimed Runoff	89.0	9.6	19.2	57.8	44
Quarterly Totals	212.0	67.0	146.0	435.0	215

were higher than projected, EPA would require the operator to undertake measures to meet permit limits, including providing treatment such as the system used for mine drainage.

Accidental Spills

Under Alternative B, vehicle accidents could affect surface water quality because the proposed haul road essentially parallels Sherman Creek with several crossings (see Figure 2-2, presented in Chapter 2).

Diesel fuel and lead nitrate would be transported from the facilities at Comet Beach to the process area and represent the highest risks for affecting surface water quality. In addition, dewatered tailings and waste rock would be transported to the DTF area for placement into the embankment, thereby creating the potential for surface water contamination.

Diesel fuel would also be transported from storage tanks at the marine terminal to the process area. Approximately 1,300 fuel shipments per year using a 5,000-gallon tanker truck would be required to supply fuel for vehicles and power generation. The maximum consequences of a transportation accident and spill would be the release of 5,000 gallons of diesel fuel to Sherman Creek with the potential for migration to Lynn Canal.

Approximately two truck shipments each carrying about 5 tons of lead nitrate would be required each year to support ore-processing operations. The worst-case scenario would be a lead nitrate transportation accident releasing 5 tons of lead nitrate to Sherman Creek with the potential for migration into Lynn Canal.

The transport of dewatered tailings from the process areas to the DTF embankment would require approximately 28,600 truck shipments per year using trucks with a 50-ton capacity. The worst-case scenario would be a transportation accident releasing 50 tons of tailings to Sherman Creek. More likely, a much smaller volume would be released to the creek because the road is generally at least several hundred feet from the stream. The potential impacts would include potential damming of the channel from the tailings, diversion of surface flows, and flooding above the upper banks, which would create overland flows. Tailings eventually would be transported to Lynn Canal. The potential impacts on the water quality of lower Sherman Creek that would result from a spill or discharge of tailings would depend on the volume of flows to dilute pollutants and the rate of discharge to the creek. Data from leachability tests of the flotation tailings show very low concentrations of toxic pollutants, which are not appreciably different from background levels in Sherman Creek. The *Technical Resource Document for Water Resources* (SAIC, 1997) presents a detailed discussion of tailings test results.

Section 4.13 discusses the expected transportation traffic and the probability of spills for trucks carrying tailings, diesel fuel, and lead nitrate. Sections 4.6 and 4.7 discuss the potential impacts of spills on fisheries.

4.4.4 Effects of Alternative C (Marine Discharge)

The potential impacts to surface water quality from Alternative C would be very similar to those described for Alternative B in Section 4.4.3. The major differences relevant to potential impacts to surface water are that under Alternative C, 1) diesel fuel would be transported from the marine terminal to the process area by pipeline and 2) mine water and DTF effluent would be combined and discharged directly to Lynn Canal. Process area runoff would be discharged to lower Sherman Creek via the sediment detention pond.

Sedimentation

The total area disturbed under Alternative C would be 253 acres. Under this alternative, a pipeline would be constructed to transport diesel from the tanks located at the marine terminal to the process area and powerplant. The potential for erosion and sedimentation to Sherman Creek would increase during the construction phase of this pipeline. This initial construction would provide a temporary disturbance paralleling the access/haul road for 2.2 miles (approximately 2.7 acres). Sedimentation impacts to Sherman Creek are anticipated to be low from this activity. BMPs would be employed during construction to control erosion and sediment loading to the stream. Mulching and revegetation would be used to reclaim the disturbed area.

Under Alternative C, treated mine water and DTF effluent would be piped to Lynn Canal for discharge. Alternative C would include the same potential sediment-related impacts associated with discharge of process area runoff as Alternative B. Sediment loadings would not occur to fresh water from mine drainage or DTF effluent. It is anticipated that sedimentation impacts to Sherman Creek would be low from construction of the effluent pipeline. BMPs would be employed during construction to control erosion and sediment loading to the stream. Mulching and revegetation would be used to reclaim the disturbed area. Potential impacts could only occur from a pipeline rupture and spill, as discussed in the following section.

Effluent Quality

Under Alternative C, DTF or mine drainage discharges would not affect fresh water quality because of the marine discharge. In addition, site-specific criteria for TDS and sulfate would not be needed for Sherman and Unnamed creeks. Impacts could only occur from a pipeline rupture and spill. Under Alternative C, the potential water quality effects from process area runoff, including runoff from the temporary waste rock pile, are the same as under Alternative B (see Section 4.4.3).

Accidental Spills

Vehicle accidents or a rupture of the diesel or effluent pipelines could affect surface water and water quality. The potential for impacts from vehicle accidents under Alternative C are the same as those described for Alternative B for lead nitrate and tailings (see Section 4.4.3). The potential for vehicle accidents, spills, and impacts to Sherman Creek by trucking diesel would be eliminated by the pipeline.

The relative proximity of the diesel pipeline to the Sherman Creek channel would provide the potential for leakage of fuel to surface water. The worst-case scenario for a pipeline rupture would be that the entire pipe volume of diesel fuel would flow into Sherman Creek. The maximum volume of the pipeline is estimated to be 17,000 gallons.

Under Alternative C, mine drainage and DTF effluent would also be piped to Lynn Canal for discharge. The mine drainage and the DTF effluent streams are expected to nearly meet both fresh water and marine water quality standards. Therefore, an individual spill would not significantly affect water quality in Sherman Creek or Unnamed Creek.

Section 4.13 discusses transportation traffic and the probability of spills for trucks carrying lead nitrate and tailings and presents the probability of a diesel pipeline rupture. Sections 4.6 and 4.7 discuss the potential impacts of spills on fisheries.

4.4.5 Effects of Alternative D (Modified DTF Design)

Sedimentation

The total area disturbed under Alternative D would be 270 acres. The tailings slurry pipeline would increase the potential for erosion and sedimentation to Sherman Creek, both during the initial construction phase and throughout the mine operation. The pipeline would provide a linear disturbance paralleling the access/haul road for 1.5 miles, which is approximately 1.8 acres. The return recycle pipeline would parallel the slurry pipeline and result in no significant increase in the area disturbed. It is anticipated that the potential sedimentation impacts to Sherman Creek would be low from this activity. BMPs would be employed during construction to control erosion and sediment loading to the stream. Mulching and revegetation would be used to reclaim the disturbed area from the initial construction, and BMP practices would be employed to minimize erosion along the pipeline during mine operation.

Alternative D incorporates a modified design for the DTF embankment that would involve construction of an engineered structural berm. This design would increase the size of the footprint approximately 18 acres, providing more surface area available for erosion. Because of the use of BMPs and the projected performance of the sediment detention pond, this design modification is not anticipated to significantly change the potential for sediment loadings and impacts to surface water from those described under Alternatives B and C in Sections 4.4.3 and 4.4.4, respectively.

Effluent Quality

The potential impacts associated with the discharge of process effluents or waste sources are the same as those described for Alternative B in Section 4.4.3.

Accidental Spills

The potential for impacts from vehicle accidents under Alternative D are the same as those described for Alternative B for lead nitrate and diesel. Under Alternative D, the potential

for vehicle accidents, spills, and impacts to Sherman Creek by trucking tailings would be eliminated by a tailings pipeline to the DTF area. A catastrophic rupture of the tailings pipeline near the dewatering facility would result in a release of 270,000 gallons and associated solids; however, spills would most likely be much smaller in magnitude and involve substantially less material. Minor pipeline failures would be contained within the pipeline's secondary containment (double walls). Although the pipeline parallels the haul road, any released material could spill to Sherman Creek. The operator characterized flotation tailings produced from two pilot-scale milling runs in 1996. These data show very low levels of leachable pollutants in the tailings.

Section 4.13 discusses transportation traffic and the probability of spills for trucks carrying diesel fuel and lead nitrate and presents the potential for a tailings pipeline rupture. Sections 4.6 and 4.7 discuss the potential impacts of spills on fisheries.

4.4.6 Cumulative Effects

The potential impacts to surface water quality as a result of the Kensington Gold Project would be limited to the Sherman Creek watershed and the small drainage basin located between the lower main channel of Sherman Creek and the lower main channel of Sweeny Creek. Creeks within these basins drain to Lynn Canal. If developed, the Jualin Project would be located within the Johnson Creek watershed to the west of Sherman Creek. Johnson Creek drains to Berners Bay. Because these projects would be located in different watersheds, no cumulative impacts to either watershed would be expected as a result of project development unless common facilities were used for mine drainage and/or tailings management. Although common facilities likely would increase the volume and/or duration of discharges, effluent discharges would still be required to meet TSS and water quality-based NPDES permit limits. As a result, additional impacts on water quality are not expected.

4.4.7 Summary

The potential for impacts from sedimentation would be the greatest during construction periods for all alternatives. The degree of erosion and sedimentation are a function of the intensity and volume of storm events. Alternative A would have the largest area of disturbance (281 acres) of all alternatives, thereby providing the greatest potential for erosion and sedimentation, especially during construction periods. Alternatives B through D would have similar areas of disturbance, with Alternative B being the lowest (250 acres). The small differences in acreages potentially disturbed among Alternatives B through D are because of proposed pipelines; Alternative C would have a diesel pipeline, and Alternative D would have a tailings slurry pipeline. Pipeline construction would create a linear disturbance along lower Sherman Creek, thereby increasing the potential for erosion and impacts to water quality.

Under Alternative A, marine discharge would eliminate the potential fresh water quality impacts from pollutant loadings from the impoundment. Sherman Creek only could be affected from an unlikely failure of the tailings dam. Treated mine drainage and process area storm water

would be discharged to lower Sherman Creek under Alternatives B and D; however, minimal impacts to surface water quality are expected. Marine discharge to Lynn Canal under Alternative C would eliminate pollutant loadings, and the associated potential impacts, to Sherman Creek and Unnamed Creek from treated mine drainage and DTF effluent.

Accidental spills or pipeline ruptures of fuels and process effluents under all alternatives could affect the water quality of lower Sherman Creek. Alternative A would have onsite processing using cyanide. Alternatives B through D would not involve onsite processing and, therefore, would eliminate cyanide as a potential source of surface water impacts. Alternatives B and D would include increased use of diesel fuel and, therefore, potential for diesel spills.

4.5 GROUND WATER HYDROLOGY AND QUALITY

The Kensington Gold Project could affect local ground water hydrology and quality. Activities that could affect ground water resources and quality include mine drainage, treatment, and water discharge; waste rock storage; tailings storage; and accidental spills from transportation accidents or pipeline ruptures. Ground water hydrology could be affected by drawdowns of local aquifers, which could change the amount of water reaching receiving streams. The placement of the tailings disposal areas could affect the amount of infiltration serving to recharge shallow aquifers. In addition, chemical constituents of leachate from tailings or waste rock could affect ground water quality. The exposure of ground water to air within the mine workings also could produce changes in ground water chemistry.

Some impacts to ground water have occurred already because of the historic mining activities and recent exploration. At present, ground water collects in existing areas of the mine and discharges to the surface after treatment through a pond system. This flux of ground water into the mine affects the natural ground water recharge-discharge characteristics of the area by creating a small drawdown in the ground water table.

The potential impacts to ground water do not differ significantly among Alternatives B, C, and D. This section, therefore, only analyzes the potential impacts on ground water hydrology and ground water quality associated with Alternative A and those that are common for Alternatives B through D. The potential environmental effects caused by each alternative are discussed using changes in hydrology and water quality as indicators.

4.5.1 Effects of Alternative A (No Action)

Ground Water Hydrology

Mine Workings

The underground mine drainage currently causes, and will continue to produce, changes in the ground water flow direction and recharge rates in the vicinity of the active mine workings. Ground water in the area would flow toward the underground workings. The zone of influence of the mine drainage is limited, however, because of the low permeability of the aquifer and the steep surficial topography of the strata. Combined with the fact that ground water is not used in

the area, these impacts to ground water hydrology would be localized and are not considered significant.

Tailings Management

The 225-acre tailings impoundment would be constructed over generally low permeability sediments of the glaciofluvial and glaciolacustrine tills. Measurements for hydraulic conductivity in this area have ranged between 7.4×10^{-6} and 8.8×10^{-7} centimeters per second; this part of the basin is considered to be gaining (i.e., net water balance is generally increasing). These two factors combine to suggest that potential impacts to the recharge and natural discharge of ground water in this area would not be significant.

Ground Water Quality

Mine Workings

Impacts to ground water quality could include chemical changes as ground water is exposed to oxygen in the mine workings. Existing monitoring data on mine drainage generally show no evidence of acid generation or variation from natural background quality. Sections 3.8.1 and 3.8.2 summarize existing ground water monitoring data.

Waste Rock Seepage

Water leaching through waste rock and infiltrating to ground water could impact ground water quality. Under Alternative A, waste rock would be used in construction of the tailings embankment, road surfacing, rip-rap, and final reclamation activities. Some waste rock would remain in the pile within the impoundment drainage area. The *Technical Resource Document for Water Resources* (SAIC, 1997) presents the results of geochemical testing of ore and waste rock. These data suggest that both the potential for impacts related to poor quality leachate and the acid generation potential of these minerals are very low.

Tailings Seepage

Direct seepage from the tailings impoundment into the ground water system and subsequent ground water contamination could affect water quality. Under Alternative A, the operator would construct a collection pond downstream of the tailings embankment to collect seepage. Collected water would be recycled back to the impoundment. The water quality of the seepage would be monitored throughout the mine operation to provide data necessary to determine the need for seepage water quality control measures after final reclamation.

Accidental Spills

Any accidental spill or rupture of a pipeline could impact ground water quality through infiltration of liquids directly into the ground or from infiltration of waters contaminated from the spill. The main sources of potential contamination are the accidental spill or rupture of the marine discharge pipeline and transportation of hazardous materials. Section 4.4 discusses the potential for accidental spills or ruptures of pipelines under Alternative A.

4.5.2 Effects Common to Alternatives B Through D

Ground Water Hydrology

Mine Workings

The potential impacts associated with mine development on ground water hydrology and ground water quality are the same as those discussed for Alternative A in Section 4.5.1. The development of the mine and the mine workings are not expected to affect the ground water hydrology in the Sherman Creek basin.

Tailings Management

The construction of the DTF would include installation of diversions to carry upslope surface water runoff around the facility. These diversions would contact bedrock and could intercept ground water. Although the interception of ground water should not affect the overall site hydrology, any unsalvaged organic material underlying the DTF would be drained. Draining the organic layers below the DTF would be necessary to support its long-term stability. While dewatering of this material would cause an impact locally, the effects would be limited to areas where drainage is necessary for structural stability. Therefore, the DTF and its associated facilities are not expected to significantly impact ground water hydrology.

Ground Water Quality

Mine Workings

The potential impacts on ground water quality from Alternatives B through D associated with the mine workings would be similar to those described for Alternative A in Section 4.5.1. As discussed previously, flotation tailings and waste rock would have little or no acid generation potential and undetected or very low concentrations of pollutants. Therefore, paste backfill of flotation tailings and backfill of waste rock should not affect ground water quality.

Waste Rock Seepage

Water leaching through waste rock and infiltrating to ground water could impact ground water quality. Waste rock could be used in construction of the DTF and for mine backfill. The operator anticipates that the entire volume of waste rock would be used in the development of the DTF; however, a temporary storage pile would be maintained near the mine portal for the first 3 to 4 years of operation. Section 2.3.3 provides a detailed description of waste rock management under Alternatives B through D. As discussed previously, geochemical testing indicates that impacts on ground water quality from waste rock are not expected.

Tailings Seepage

The low permeability layer underlying the DTF would be designed to minimize contact between tailings seepage and ground water. Seepage would be drained and routed to a sediment detention basin and discharged to Unnamed Creek. Geochemical testing of flotation tailings

show virtually no acid generation potential and undetected or very low concentrations of toxic pollutants. Therefore, impacts to ground water quality are not expected from seepage from the DTF.

Accidental Spills

Any accidental spill or rupture of a pipeline could impact ground water quality through infiltration of liquids directly into the ground or from infiltration of waters that have become contaminated from the spill. Sections 4.3 and 4.13 discuss the potential sources of spills or accidents and the probability of occurrence for Alternatives B through D.

4.5.3 Cumulative Effects

The potential cumulative impacts on ground water hydrology could occur from development of the Jualin Project southeast of the Kensington Gold Project. If underground workings of the two projects come in proximity, the drawdown in the ground water table created from mine dewatering activities in the two mines could converge. This could create a combined cone of depression in the ground water and affect the area's recharge/discharge relationships. As analyzed in the FEIS, these cumulative effects are not anticipated to be significant, however. Pages 4-35 and 4-36 of the FEIS discuss potential cumulative impacts in detail.

4.5.4 Summary

The potential impacts associated with mine development on ground water hydrology and ground water quality would be the same for all alternatives. Potential impacts to hydrology in the Sherman Creek basin or to water quality are not expected from either the development of the mine or mine workings.

Waste rock would be primarily managed and disposed of in the tailings impoundment under Alternative A and disposed of in the DTF embankment or backfilled under Alternatives B through D. Geochemical testing and modeling conducted by the operator indicate that potential impacts to ground water quality would not be significant under either of these approaches.

The potential impacts to ground water from tailings seepage would not be significant under any alternative. Under Alternative A, tailings impoundment seepage would be collected in a pond and monitored to determine the need for any mitigation after closure. Under Alternatives B through D, seepage from the DTF would also be collected during operations. Flotation tailings have negligible acid generation potential and would not be expected to affect ground water quality.

A spill or pipeline rupture under all the alternatives could affect ground water quality. The potential impacts from a cyanide spill could only occur under Alternative A.

4.6 AQUATIC RESOURCES - MARINE

Implementation of any of the alternatives would have the potential to affect the marine environment. Effects to the marine environment can be assessed through chemical changes in water quality and physical changes to marine habitats. The following indicators were used to assess the extent of potential impacts to the marine environment:

- Water quality
- Sedimentation
- Integrity of marine habitats.

None of the alternatives is expected to have any measurable effects on oceanographic processes within Lynn Canal. Currents and tides can affect the dispersion and fate of wastewater discharges to Lynn Canal and materials spilled in Lynn Canal. Therefore, this section discusses oceanographic processes that could affect the significance of potential impacts to marine water quality and biological resources.

4.6.1 Effects of Alternative A (No Action)

Water Quality

Wastewater Discharge

Under Alternative A, wastewater would consist of effluent from the tailings impoundment (i.e., tailings water and mine water) that would be treated by enhanced settling to remove the larger suspended solids. The NPDES permit would define receiving water limits for the wastewater discharge. Following discharge, the effluent plume would rise in the water column, due to its lower density and buoyancy, and mix rapidly with ambient sea water. Mixing between the effluent plume and receiving waters would dilute the wastewater. The resultant constituent concentrations would depend on the initial concentrations in the effluent, plume dilution rates, and settling of effluent particles. Table 4-19 lists the estimated concentrations of trace metals in the effluent before initial dilution. The *Technical Resource Document for Water Resources* (SAIC, 1997) discusses the approach for deriving these estimates, including new data compiled by the operator since publication of the FEIS. Cyanide would require the largest dilution (31:1) to achieve compliance with the applicable standards. With a projected discharge rate of 3,200 gpm, a mixing zone of about 100,000 gallons or 13,700 cubic feet (i.e., a cube 24 feet on each side) of sea water would be necessary. If Alternative A is selected as the preferred alternative, EPA and ADEC will make a final determination on the size of a mixing zone during the NPDES permitting process.

Exposure of aquatic organisms to the effluent plume within the mixing zone would pose the greatest potential for acute or chronic toxicity. Due to the size of the mixing zone and the nature of the effluent, however, exposure to the effluent plume is not expected to produce significant effects. As discussed in Chapter 2, the location of the outfall was moved to one-half mile offshore at a depth of about 300 feet. This was done in response to comments in the TAR and

Table 4-19. Marine Discharge Quality Under Alternative A

Parameter	Background, Lynn Canal (µg/l) [a]	Predicted Marine Discharge Quality, Outfall 001 (µg/l) [b]	Average Monthly Limits (µg/l)[b]	Dilution Factor
Ag	0.001	0.3	1.88	NA
As	1.48	2.7	1.4[c]	NA
Cd	0.2	0.2	7.61	NA
Cr	0.2	4.3	40.94	NA
Cu	0.85	13.7	2.37	8.44:1
Hg	0.0007	0.04	0.02	2.16:1
Ni	0.08	5.3	5.81	NA
Pb	0.17	10.0	4.59	2.23:1
Se	ND	2.8	10.0	NA
Zn	1.2	20.5	47.49	NA
CN	ND	25.5	0.82	31.07:1

a. EPA, 1994.

b. See the *Technical Resource Document for Water Resources* (SAIC, 1997) for derivation of outfall characteristics and NPDES permit limits.

c. As discussed in Section 4.4, the method detection limit for arsenic is 3.0 µg/l. Compliance with permit limits would be demonstrated by reporting concentrations less than 3.0 µg/l. Because the projected arsenic concentration at outfall 001 is less than 3.0 µg/l, no dilution would be required.

NA = Not Applicable.

ND = Non-Detect.

by local fisherman related to nearshore eddies in the vicinity of Point Sherman. These eddies could have affected mixing and available dilution at the outfall location identified in the FEIS. The new outfall location was established based on a study in 1995 on currents near Point Sherman (Echo Bay Mines, 1995). This study indicates that nearshore eddies form in shallow (less than 100 feet) waters within one-quarter to one-half mile offshore. By locating the outfall one-half mile offshore at a depth of 300 feet, the discharge would be beyond the eddy influences. In addition, the new location is outside of the primary nearshore commercial fishing area.

The potential for bioaccumulation of effluent-derived metals also is small. The greatest potential for tissue bioaccumulation of metals would be for bottom-dwelling invertebrates, which could ingest effluent particles deposited on the seafloor. Because the magnitude of expected changes in sediment metal concentrations attributable to the effluent discharge is small, the potential for significant increases in bioaccumulation is considered negligible.

The wastewater discharge would be required to meet NPDES permit limits for a daily maximum TSS level of 30 mg/l and a monthly average of 20 mg/l at the point of discharge. Compliance would be achieved using BMPs throughout the catchment area and enhanced settling in the impoundment. Effluent discharges could result in elevated suspended solids concentrations within the immediate vicinity of the outfall. Proportional reductions in light transmittance could be associated with the elevated suspended solids concentrations; however, any effects from reduced light transmittance on phytoplankton productivity are expected to be insignificant.

Sewage included in the tailings effluent would not be expected to have significant impacts on marine aquatic resources because the wastewater should not contain appreciable levels of any substances considered potentially toxic or harmful to marine organisms. Bacteria present in the sewage effluent could be consumed and accumulated by filter-feeding bivalves.

Accidental Spills

Alternative A would use LPG as the primary fuel for onsite operations. LPG is extremely volatile and would evaporate rapidly from a spill to surface waters or to the ground. Therefore, LPG is not expected to persist in the marine environment, and potential impacts to water quality probably would be localized and temporary.

The most likely source of diesel spills to Lynn Canal under Alternative A would be transfers, such as between barges and storage tanks, with relatively small volumes. Vessel groundings, collisions, or other accidents causing a rupture in a vessel hull could release large volumes of diesel fuel, although the probability of these spills is considerably lower than the probability of a spill during fuel transfer (see Section 4.1.3).

The dispersion of diesel within Lynn Canal would depend on the combined strength of tidal currents, wind and wave mixing, longer period current patterns, and the extent of previous weathering (i.e., changes to the physical/chemical properties of the material). Diesel consists primarily of low to medium molecular hydrocarbon compounds that are relatively more volatile and water soluble than the higher molecular weight components of crude oils. Therefore, a relatively greater proportion of a diesel spill is lost to evaporation and dissolution than occurs with a crude oil spill. Although diesel is more volatile than crude oils, some of the soluble components, such as the lower molecular weight aromatic compounds, can be acutely toxic to marine organisms. In addition, polycyclic aromatic hydrocarbons (PAHs) within diesel can bioaccumulate in the tissues of marine invertebrates exposed to fuel spills. Bioaccumulation of PAHs in fish tissues are not a concern because fish can metabolize PAHs. Chronic exposures to PAH-contaminated sediments near urbanized settings, however, have been suggested as a possible cause for development of tissue pathologies in bottom-dwelling fish.

Conditions promoting the greatest longevity of diesel fuel residues in the environment would be burial in intertidal muds or marshes, where the potential for evaporation and dissolution/dilution is minimized. Because intertidal muds and marshes do not occur in the immediate vicinity of the project area, the long-term persistence of diesel resulting from a spill is not expected. In addition, it is unlikely that significant portions of a diesel spill would sink to the bottom of Lynn Canal.

Cyanide spilled into Lynn Canal would dissolve readily in water, thereby resulting in acute toxicity to marine organisms within the immediate vicinity of the spill. Long-term changes to water quality would not be expected because cyanide degrades rapidly in the environment. Spills of other chemicals, including chlorine and caustics, are potential sources of acute toxicity to marine organisms. Long-term impacts to water quality are unlikely, however, because these materials would not persist in a toxic form.

Sedimentation

The effluent discharge under Alternative A would not exceed the monthly average TSS limit of 20 mg/l and the daily maximum limit of 30 mg/l included in the NPDES permit. Therefore, the passage of light would not be affected by the discharge.

Because trace metals in the effluent probably would adsorb onto suspended particles, deposition and accumulation of effluent particles in bottom sediments are potential concerns. Based on modeling results described in the FEIS, settling of effluent particles would be expected to increase the yearly solids deposition rates near the outfall by 3 percent. In addition, accumulation of effluent particles on the bottom could result in increased metals concentrations in bottom sediments of less than 15 percent, with the exception that lead concentrations in sediments near the outfall could increase by an estimated 74 percent above background levels. Changes in solids deposition rates of 3 percent and in sediment metal concentrations of less than 15 percent are considered to be within the range of natural variability.

Under Alternative A, excavation for construction of a temporary barge landing site at Comet Beach could impact marine water quality. Excavation probably would result in short-term increases in suspended sediments in the nearshore waters adjacent to the excavation site. In general, increased suspended sediment concentrations could reduce water clarity and light transmittance of surface waters. Because the nearshore sediments are primarily cobbles (see Chapter 3), which should settle rapidly to the bottom, however, the magnitude and duration of this effect are expected to be minor. Similarly, soils from erosion and/or other materials generated by runoff from other portions of the project area could be transported to Lynn Canal. The potential impacts to nearshore water quality from runoff also are expected to be minor and comparable to the potential effects from discharges by adjacent creeks and streams.

Integrity of Marine Habitats

The construction of the marine terminal would require dredging a portion of Comet Beach in the immediate vicinity of the barge landing area. The dredging would physically disturb approximately 2.3 acres of the cobble beach habitat. The potential for significant impacts from construction and operation of the facility on marine organisms or sensitive habitats is negligible. Increases in suspended particle concentrations are expected to be temporary and localized. Disturbances of substrate also would be localized, and newly constructed facilities probably would be recolonized rapidly.

4.6.2 Effects Common to Alternatives B Through D

Water Quality

Wastewater Discharge

Under Alternatives B through D, sanitary wastewater from the Comet Beach area would undergo secondary treatment prior to discharge to Lynn Canal. Sewage effluent can be a source of suspended solids, organic materials, nutrients, and fecal bacteria and viruses. Because the

nearshore waters of Lynn Canal are well mixed, significant accumulations of solids and organic matter from the sewage effluent are not expected. Similarly, eutrophication and oxygen depletion of bottom waters due to increased oxygen demand are not expected. Bacteria and viruses associated with the sewage would experience natural die-off; therefore, the accumulation of bacteria and pathogens in Lynn Canal is not expected.

The discharges of treated sewage represent a potential source for nutrients that could stimulate phytoplankton production within a localized area of Lynn Canal. This effect could be offset by related reductions in light transmittance, however, caused by elevated localized turbidity associated with the effluent plume.

Accidental Spills

Alternatives B through D would use diesel as an onsite energy source. The potential impacts resulting from a diesel spill would be the same as those discussed under Alternative A. However, the probability of a spill would be greater because of the increased use. Compared to Alternative A, therefore, Alternatives B through D have a higher probability for potential impacts to aquatic organisms from diesel spills. The potential impacts from spills of cyanide and chlorine would be eliminated because these materials would not be stored or used onsite.

Under Alternatives B through D, ore concentrate would be shipped weekly from the site. The material would be containerized as 1,400-ton loads and transported by barge. Spills of ore concentrate would not be a concern unless containers ruptured, in which case any potential impact would be insignificant and short-term.

Sedimentation

Increases in suspended particle concentrations due to excavation of the landing and/or runoff-related inputs of particles (e.g., soils) to nearshore areas of Lynn Canal would be similar to those described for Alternative A. The magnitude and duration of any potential impacts to marine water quality would be insignificant.

Integrity of Marine Habitats

Under Alternatives B through D, a marine terminal would also be constructed. As described for Alternative A, construction of the facility would require dredging approximately 2.3 acres of Comet Beach in the immediate vicinity of the barge landing area. The dredging would result in a localized physical disturbance of the cobble beach habitat. The potential for significant impacts from construction and operation of the facility to marine organisms or sensitive habitats is negligible. Increases in suspended particle concentrations are expected to be temporary and localized. Disturbances of substrate also would be localized, and newly constructed facilities probably would be recolonized rapidly.

4.6.3 Effects of Alternative B (Proposed Action)

Water Quality

Wastewater Discharge

The potential impacts from Alternative B to marine water quality are associated with 1) direct discharges of treated sanitary wastewater to Lynn Canal and/or 2) indirect impacts from fresh water discharges containing elevated suspended solids, trace metals, and/or nutrients. The effects of direct discharges of sanitary wastewater are addressed in Section 4.6.2. The effects to marine water quality from outflow from Sherman Creek and Unnamed Creek are expected to be insignificant, assuming that the fresh water discharges meet all NPDES permit limits. Therefore, no acute or chronic toxicity to marine organisms from exposures to the stream inputs to Lynn Canal is expected.

Sedimentation

Under Alternative B, trace metals transported by river runoff are expected to adsorb onto natural suspended particles and eventually settle to the bottom of Lynn Canal. The deposition and accumulation of sediment-associated trace metals within shoreline areas of Lynn Canal would be unlikely due to the naturally high turbulence that is responsible for erosion of fine-grained sediments. Instead, small particles probably would be transported to the deeper, quiescent areas of Lynn Canal. Regardless, incremental increases in the trace metal concentrations of these particles are not expected to result in significant increases in metal concentrations and subsequent decline in the quality of bottom sediments. Similarly, no significant changes in uptake and accumulation of metals in tissues of marine organisms are expected.

4.6.4 Effects of Alternative C (Marine Discharge)

Under Alternative C, treated mine drainage and DTF effluent would be combined and discharged directly to Lynn Canal.

Water Quality

Wastewater Discharge

Table 4-20 lists the projected composition of the marine discharge and projected water quality-based NPDES permit limits for Alternative C. The *Technical Resource Document for Water Resources* (SAIC, 1997) describes the approach used for determining the discharge characteristics. A mixing zone would be needed for compliance with the water quality-based permit limit for copper. For a combined DTF effluent and mine drainage discharge of 1,435 gpm, the discharge would require mixing with 6,113 gallons or 825 cubic feet (a cube approximately 9 feet on a side) of sea water. Under Alternative C, the untreated discharge would be through a multiport diffuser located 300 feet offshore at an elevation of 30 feet below the low-tide elevation.

Table 4-20. Marine Discharge Quality Under Alternative C

Parameter	Background, Lynn Canal (µg/l) [a]	Predicted Marine Discharge Quality, Outfall 002 (µg/l) [b]	Average Monthly Limits (µg/l) [c]	Dilution Factor (µg/l)
Ag	0.001	0.12	1.88	NA
As	1.48	2.07	<3.0[d]	NA
Cd	0.2	ND[e]	7.61	NA
Cr	0.2	ND[e]	40.94	NA
Cu	0.85	8.85	2.37	4.26:1
Hg	0.0007	ND[e]	0.02	NA
Ni	0.08	0.41	5.81	NA
Pb	0.17	1.27	4.59	NA
Se	NA	0.01	10.0	NA
Zn	1.2	12.95	47.49	NA

a. EPA (1994).
b. Derived from combining flow-weighted projected untreated mine drainage and DTF effluent concentrations as discussed in Section 4.4 and Table 4-17.
c. See the *Technical Resource Document for Water Resources* (SAIC, 1997).
d. As discussed in Section 4.4, the method detection limit for arsenic is 3.0 µg/l. Compliance with permit limits would be demonstrated by reporting concentrations less than 3.0 µg/l. Because the projected arsenic concentration at outfall 001 is less than 3.0 µg/l, no dilution would be required.
e. Non-detected values represent characterization data for multiple streams; see SAIC (1997) for detection limits for each stream.
NA = Not Applicable.
ND = Non-Detect.

As discussed in Chapter 2, the nearshore discharge location was selected because of the limited size of the mixing zone required under Alternative C. The minimal necessary dilution should be available despite the presence of nearshore eddies. If Alternative C is selected, the final location of the outfall and extent of any mixing zone will be determined during the NPDES permitting process. If a mixing zone was not granted by the State, additional treatment comparable to the mine drainage treatment system under Alternatives B and D would likely be necessary to meet NPDES permit limits.

Sedimentation

The potential impacts from sediment in the effluent discharge under Alternative C would be comparable to Alternative A, because both discharges would not exceed the monthly average TSS limit of 20 mg/l and daily maximum limit of 30 mg/l required by the NPDES permit. Alternative C, therefore, would not affect the passage of light.

4.6.5 Effects of Alternative D (Modified DTF Design)

The potential effects on marine aquatic resources from Alternative D would be similar to those described for Alternative B in Section 4.6.3.

4.6.6 Cumulative Effects

Lace River Hydroelectric has proposed development of a hydroelectric power generation facility, which would be located across the Lace River from the Kensington Gold Project. This development could provide additional opportunities for a power source at the mine. Although it would reduce onsite fuel requirements, it would require construction and maintenance of transmission lines across the Lace River. Plans for the Lace River Project are not finalized. If and when a final development plan is proposed to the Federal Energy Regulatory Commission and the operator agrees to purchase power, the effects on marine water resources would be evaluated under the NEPA process for the Lace River Project and/or modifications to the Kensington Gold Plan of Operations.

4.6.7 Summary

Table 4-21 presents the differences among the four alternatives in regard to marine resources. Only Alternatives A and C propose a marine discharge for process wastewater, although domestic wastewater would be discharged to Lynn Canal under all alternatives. Effluent generated under Alternative A would be piped to one-half mile offshore Lynn Canal and would require a mixing zone of approximately 13,700 cubic feet (a cube 24 feet on a side) to meet the water quality-based permit limit for cyanide. Under Alternative C, the discharge to Lynn Canal would be nearshore and require a mixing zone of 825 cubic feet (a cube 9 feet on a side) to the water quality-based permit limit for copper. Because fuel and process reagents would be shipped to the site by barge, a spill to the marine environment would be possible under each alternative. Section 4.13 discusses the probabilities of spill under each alternative.

Table 4-21. Factors Associated With Potential Impacts to Marine Aquatic Resources

Alternative	Discharge Location	Primary Spill Concerns	Mixing Zone
A (No Action)	Marine	LPG, cyanide, chlorine, diesel	Yes
B (Proposed Action)	Fresh Water/Marine	Diesel	No
C (Marine Discharge)	Marine	Diesel	Yes
D (Modified DTF Design)	Fresh Water/Marine	Diesel	No

4.7 AQUATIC RESOURCES - FRESH WATER

All alternatives would affect fresh water aquatic resources within the Sherman Creek and Ophir Creek drainages. Impacts could result from the diversion of existing channels, the withdrawal of water for the milling process, and changes to water quality associated with construction-and operation-related discharges. The following indicators were used to compare the potential impacts of each alternative:

- Integrity of fresh water habitat
- Water withdrawal
- Water quality
- Sedimentation.

4.7.1 Effects of Alternative A (No Action)

The potential impacts associated with Alternative A would occur within the Sherman Creek drainage, including the Ophir Creek sub-basin. Stream diversions and the tailings impoundment would affect habitat directly; withdrawals and discharges within Sherman Creek could also affect water quantity and quality in Sherman Creek (see Section 4.6).

Integrity of Fresh Water Habitat

Alternative A would directly affect three stream courses: upper Sherman Creek above the confluence with Ivanhoe Creek, Ophir Creek, and South Fork Sherman Creek. These drainages would be impacted physically by the construction of the tailings impoundment and diversion of the streams around the impoundment.

Upper Sherman Creek and South Fork Sherman Creek would be routed through a buried pipeline approximately 1 mile in length. Water would be discharged back to the natural stream channel of Sherman Creek below the tailings dam. Ophir Creek and Ivanhoe Creek would be diverted for approximately 2,950 feet and discharged down a concrete spillway to lower Sherman Creek.

These diversions would eliminate approximately 6,000 feet of stream habitat. This would be fatal to 400 to 500 resident Dolly Varden residing within the natural stream channels. All fish in this section would be lost as a result of this action, with the exception of a few near the lower end that could escape when flows were cutoff. Any fish mortality associated with the Ophir Creek diversion would be less than in the Sherman Creek drainage.

Stream temperatures in lower Sherman Creek during summer would not be expected to be altered detrimentally from the diversions.

Water Withdrawal

Alternative A would require water withdrawal from upper Sherman Creek. The withdrawal would consist of approximately 0.42 cfs and would comply with minimum instream flow requirements developed by ADF&G and permitted by ADNR. Withdrawals during December, January, and February, which represent the period of critical low flows, would not be permitted most years. Restrictions also could occur in July in some years. In order to address potential water supply shortages to the mill circuit and for domestic purposes during low flows, the operator has proposed to use mine drainage and, if required, develop alternative ground water sources. These sources would be used to supply fresh water to the facility and to mitigate potential impacts during low flows. The restrictions on water withdrawal and the development of alternative sources should minimize adverse effects associated with flow reductions to aquatic habitat.

In addition, the tailings impoundment would be a source of reduced flows in lower Sherman Creek because it represents approximately 10 percent of the drainage area within the Sherman Creek drainage. Rather than passing through to Sherman Creek, drainage from this area

ultimately would be discharged to Lynn Canal through the marine discharge. The flow intercepted by the tailings impoundment is not expected to produce a significant effect on low flows below the impoundment.

Water Quality

Under Alternative A, a seepage collection facility would be located immediately downstream of the dam to protect lower Sherman Creek from contamination by tailings seepage. All seepage from the impoundment would be pumped back as recycle water under the proposed plan. If this system was to fail, some water could pass downstream. Although such material would be expected to be relatively low in metal concentrations, downstream monitoring could be conducted to ensure that background metal levels would not be exceeded. Should levels increase over time, additional measures would be required to prevent further contamination.

The worst-case scenario for leakage would be a dam failure. A dam failure is projected to result in a peak flow release of approximately 17,000 cfs and about 215,000 tons of solids transported from the tailings and embankment. Such a flow of water and sediment would severely disrupt the lower Sherman Creek environment. The streambed would be destabilized and the gravel substrate scoured. Existing habitat structure associated with large woody debris would be destroyed. Slides or slumps along some areas of the stream could be triggered, bringing in new material, including both sediment and trees. As stream flow rapidly declined, sediment would be deposited in some areas of the stream. Fish and aquatic invertebrates would be reduced to very low levels as a result of these events, although they probably would not be eliminated. Subsequently, the stream would be expected to recover over a period of several years. As discussed in Section 4.2, the likelihood of a dam failure is very low.

Following project termination, the Sherman Creek channel would be reconstructed through the upper portion of the tailings impoundment to the Ophir Creek diversion near the dam, and the Sherman Creek diversion would be closed off. Both Ophir and Sherman creeks would be routed through the tailings structure. All flows would be routed to lower Sherman Creek downstream of the dam. Permanent erosion control measures would be implemented to protect surface waters from siltation originating on disturbed areas or the roads.

The effectiveness of the proposed plan for making the site suitable for fish production would depend on site stability and water quality. The highest priority for the reclamation effort would be ensuring channel stability, followed closely by recreating viable populations of resident fish. The conceptual reclamation plan for the tailings impoundment would provide an opportunity to evaluate the design and reclamation methods for these types of projects. Given natural low densities of resident Dolly Varden in Sherman Creek, habitat could be created to produce more fish than currently exist. Stock from the upper reaches of Sherman Creek upstream of the proposed diversion would be used to rebuild the population in the area to be reclaimed. Utilizing stock from the same stream would facilitate the maintenance of genetic integrity for the population.

4.7.2 Effects Common to Alternatives B Through D

Integrity of Fresh Water Habitat

Under Alternatives B through D, the south tributary of Ophir Creek would be diverted into Ivanhoe Creek, which would result in the loss of approximately 2,450 feet (0.5 miles) of natural stream channel (SRK, 1996h). All fish in this section would be lost as a result of this action, except for a few near the lower end that could escape when flows were cutoff. Fish densities are low in this region; however, direct estimates are not available. The estimate for the middle section of Sherman Creek is approximately one fish per 500 square feet of water surface, which probably exceeds the densities in Ophir Creek. Using the Sherman Creek densities as a worst-case assessment, between 125 and 170 resident Dolly Varden could be lost directly because of the Ophir Creek diversion.

In addition, the DTF would impact six small stream systems. Storm water and drainage would be collected and routed through the diversions. These stream systems do not appear to support fish populations and might be ephemeral. Invertebrate populations probably are sparse and transitory. Loss of these drainages probably would have a negligible impact on aquatic populations within the project area.

Five stream crossings would be required by the haul road. All road construction activities would be timed to avoid critical periods for anadromous fish. The Forest Service and ADF&G would coordinate to identify these periods.

One haul road crossing of an unnamed tributary to lower Sherman Creek would be required below the explosives storage area (see Figures 2-2 through 2-4). Because this tributary is usually dry and only flows as a result of precipitation events, this crossing would not impact aquatic habitat. Appropriate Forest Service BMPs for construction would be used during culvert installation to minimize erosion, and installation would not be conducted during a period when the tributary was flowing (SRK, 1996h).

A bridge would be constructed over South Fork Sherman Creek above the stream channel. Construction could create temporary erosion of sediments to the stream; however, sedimentation impacts from the bridge or its construction to spawning gravels or aquatic habitat would not be expected to be significant. Appropriate Forest Service BMPs would be implemented during construction to minimize erosion and potential impacts.

Two road crossings would be required on upper Sherman Creek, totaling 380 feet and 300 feet, respectively (see Figures 2-2 through 2-4). In addition, one road crossing would be required on Ivanhoe Creek, totaling 200 feet in stream length. These crossings would be constructed using long-span, low-profile, bottomless arch conduits to route creek flows (SRK, 1996h). These conduits would be designed to maintain natural creek bed conditions and to minimize impacts to the channel that would result from installation. Appropriate Forest Service BMPs would be implemented during construction to minimize erosion, limit the number of times equipment crossed the existing creek beds, and reduce the area and time of disturbance. Because of the type of conduit proposed for these crossings, impacts to aquatic habitat would be minimized. A

worst-case scenario, however, would be that fish would be eliminated from 880 feet of stream as a result of these crossings. Fish mortality would be expected to be low because individuals residing in these stream reaches would be able to escape during construction. The crossings could also result in a slight reduction of primary productivity due to a reduction in sunlight reaching the stream. Because these crossings cover only a small percentage of the drainage system, the impacts are expected to be negligible. Stream channel stability in upper Sherman Creek is primarily controlled by bedrock and large boulders. Reduction in large woody debris recruitment from the 880 feet of crossings, therefore, would not compromise channel stability.

To further minimize potential impacts, the operator would be required to evaluate the potential for eliminating the downstream road crossing on upper Sherman Creek by rerouting the haul road. The operator would also be required to evaluate reducing the length of the upstream conduit on upper Sherman Creek. One option would be to minimize the encroachment of fill for the mill site on the stream channel. These evaluations would take place during final design and construction.

Water Withdrawal

Water withdrawal under Alternatives B through D would require approximately 0.52 cfs from upper Sherman Creek during periods of non-critical flow. The withdrawals would follow instream flow requirements developed by ADF&G, which would likely prevent withdrawals during December, January, and February. These months usually represent the period of critical low flows. Restrictions also could occur in July in some years. The restrictions on water withdrawal should minimize adverse effects associated with flow reductions.

Alternatives B and D would increase flows in lower Sherman Creek because additional mine drainage would be discharged as the mine was fully developed. As discussed in Section 4.3.3, these flows are estimated to be between 1.3 and 2.2 cfs (600 and 1,000 gpm) on upper Sherman Creek below the sediment detention pond and 1.1 and 1.3 cfs (500 to 600 gpm) on lower Sherman Creek below the Ivanhoe Creek confluence. The potential impacts from these increased flows would not be significant.

Sedimentation

Under Alternatives B through D, sediment resulting from construction and, to a lesser extent, operation could be carried into Sherman Creek. The effectiveness of BMPs would determine the extent of impacts to water quality, habitat, and stream biota from erosion and sedimentation. Strict adherence to BMPs would minimize impacts, as long as weather patterns were seasonable during windows of time stipulated for sensitive work. Unseasonable rainfall patterns could overwhelm siltation control systems, however, and cause levels of impacts higher than expected. For the process area and DTF, the settling ponds are designed to collect all settleable materials. Remaining suspended sediments in settling pond effluent would not be expected to result in significant impacts to spawning gravels or aquatic habitats.

Minimal levels of impact to the biota that could occur probably would be undetectable with any form of biological monitoring. Greater levels of impact, resulting from side slope failures and excessive siltation, could reduce salmonid egg survival, juvenile salmonid overwintering survival, and benthic invertebrate abundance (Peterson et al., 1985). Incubating salmon eggs can be particularly sensitive to increases in fine sediments, especially from increased levels that occur late in the incubation phase (i.e., in late winter). Impacts from sedimentation could be of relatively short duration (i.e., 1 to 2 years). Such impacts are not expected to be significant.

4.7.3 Effects of Alternative B (Proposed Action)

Water Quality

Stream Discharges

Under Alternative B, the mine drainage and mill site runoff would be discharged to Sherman Creek at outfall 001. Water from the DTF settling pond would be discharged to Unnamed Creek at outfall 002. Available data indicate that the concentrations of metals in these discharges would be below applicable aquatic life criteria. Therefore, effects to aquatic life should be minimal. Each of these discharges would need to meet water quality-based discharge limits established under the NPDES permit. Because the discharge limits are established to protect aquatic life, adherence to these criteria should avoid impacts to organisms inhabiting Sherman Creek.

Evidence indicates that elevated metals exist in the tissues of Dolly Varden downstream from the current sediment pond outfall to the Ophir Creek tributary (Konopacky Environmental, 1996a) (see Section 3.9.4). It is not clear whether this higher level of metals concentration in the tissues is from contamination from the existing settling ponds, recent exploration activity in that portion of the drainage, a higher level of historic mining activity in that portion of the drainage relative to other portions of Sherman Creek, or naturally occurring higher levels of metals in that portion of the drainage relative to other sub-drainages. Evidence from water quality studies indicates that the new discharge at outfall 001 would have lower levels of metals than the existing discharge (SRK, 1996d). Therefore, the new discharge should not lead to levels of metals in Dolly Varden tissue above those currently detected.

Accidental Spills

Spills of material potentially toxic to aquatic life in project streams could occur during transportation of fuel and process chemicals between the laydown area and the process area. Since fuel, process chemicals, and tailings would be transported by truck throughout the operation, the extent of a spill would be limited to the amount of material contained within the truck. Section 4.13 discusses the probabilities of an accident involving a spill.

Although spill containment equipment would be located at several sites and available for rapid deployment, chemicals or fuel could enter Sherman Creek or a tributary very quickly in the event of a major spill. Such an event could result in significant numbers of mortalities of fish or embryos within the stream. Process chemicals or fuel spilled in Sherman Creek would not be

expected to persist for a long period of time, because a majority of the contamination would be transported downstream and discharged to Lynn Canal. However, small concentrations of spilled chemicals or fuel could persist in stream sediments for longer periods. This could continue to affect fish beyond the period immediately following the spill. The extent of long-term contamination resulting from a spill would be determined by the size and location of the spill and the effectiveness of cleanup. Over the long-term, fish populations would likely recover.

Tailings spilled into Sherman Creek would cause impacts similar to those caused by an increase in fine sediment. Spilled tailings would not be expected to produce acute water quality changes. Increases in the suspended solids and sediment deposition could affect feeding behavior and spawning gravels until being flushed from the system.

4.7.4 Effects of Alternative C (Marine Discharge)

Integrity of Fresh Water Habitat

Alternative C contains the same Ophir Creek diversion as Alternative B; therefore, the potential impacts are the same.

Water Withdrawal

Under Alternative C, locating the outfall in Lynn Canal would reduce Sherman Creek flows relative to the potential flows from Alternatives B and D. Treated mine drainage would be discharged directly to Lynn Canal rather than to Sherman Creek, as in Alternatives B and D. Effects on stream flows under this alternative, described previously in Section 4.3.4, would not significantly impact fish in Sherman Creek.

Water Quality

Stream Discharges

Under Alternative C, the DTF effluent and mine drainage would be discharged to Lynn Canal rather than Sherman Creek (see Section 4.4.4). The potential for water quality changes to Sherman Creek and Unnamed Creek, therefore, would be minimized.

Accidental Spills

Under Alternative C, a pipeline would be used to transport fuel between the storage facilities at Comet Beach and the process area. Process chemicals and tailings would be transported by truck, as discussed previously. Section 4.13 provides more detail on the probabilities of an accident involving a spill. The probability of a spill from the pipeline is greater than that of an accident involving a tanker truck, and the potential size of a spill under Alternative C would be greater than under the other alternatives.

4.7.5 Effects of Alternative D (Modified DTF Design)

Integrity of Fresh Water Habitat

Alternative D contains the same Ophir Creek diversion as Alternative B; therefore, the potential impacts are the same.

Water Withdrawal

The water withdrawal under Alternative D would be the same as under Alternative B.

Water Quality

Stream Discharges

Under Alternative D, the mine drainage would be discharged to Sherman Creek, and DTF effluent would be discharged to Unnamed Creek, as in Alternative B. The potential impacts of Alternative D, therefore, are the same as those for Alternative B.

Accidental Spills

Under Alternative D, tailings would be transported between the process area and the DTF through a slurry pipeline. The potential for a spill from the pipeline to reach Sherman Creek is small because the pipeline would be located adjacent to the haul road. If a spill were to reach Sherman Creek, the potential impacts would be similar to those for Alternative B. Trucks would transport fuel and process chemicals. The potential for a spill of diesel fuel or process chemicals would be the same as that for Alternative B.

4.7.6 Cumulative Effects

The potential impacts to aquatic resources and fish populations as a result of the Kensington Gold Project would be limited to the Sherman Creek watershed and the small drainage basin located between the lower main channel of Sherman Creek and the lower main channel of Sweeny Creek. Creeks within these basins drain to Lynn Canal. Fish populations removed as a result of this project would be replaced upon final reclamation, thereby mitigating long-term impacts to regional fish populations.

If developed, the Jualin Project could be located within the Johnson Creek Watershed to the west of Sherman Creek. Johnson Creek drains to Berners Bay. The Jualin Project could impact aquatic resources within Johnson Creek. Discovery of additional reserves at Kensington or development of the Jualin Project using Kensington facilities could delay final reclamation and restoration of natural conditions in the Sherman Creek drainage.

4.7.7 Summary

Table 4-22 summarizes the potential impacts resulting from the construction and operation of the alternatives under consideration.

Table 4-22. Summary of Fresh Water Impacts by Alternative

Indicator	Alternative			
	A	B	C	D
Habitat Loss From Diversions (linear feet)	6,000	2,450	2,450	2,450
Fish Mortality	400-500	125-170	125-170	125-170
Water Withdrawal (cfs)	0.42	0.52	0.52	0.52

4.8 SOILS, VEGETATION, AND WETLANDS

This section discusses the potential impacts on soils, vegetation, and wetlands from the four project alternatives.

4.8.1 Soils

There are no substantive differences in terms of soils among the alternatives considered under this analysis compared to the analyses conducted in the FEIS. As indicated previously, Alternative A in the Draft SEIS corresponds to Alternative F in the FEIS; Alternatives B through D in the Draft SEIS correspond to Alternative E (Site B) analyzed in the FEIS. Pages 4-57 and 4-58 in the FEIS analyze the potential impacts to soil.

4.8.2 Vegetation

This section discusses the potential impacts to vegetation resources using the extent of vegetation disturbed as the indicator. The section is structured differently than other sections of this document because of the similarity of impacts across all alternatives. The primary difference among alternatives relative to vegetation is reflected in the total acreage disturbed.

Under all alternatives, vegetation would be cleared for construction of roads, tailings disposal areas, and facilities. These areas would remain devoid of vegetation for the life of the mine, except for the areas that could be revegetated on an interim basis. As shown in Table 4-23, the total amount of surface disturbance varies for each alternative.

Upon closure of the mine, disturbed areas would be stabilized and reclaimed according to a reclamation plan approved by the Forest Service. Reclamation activities would be expected to reestablish vegetation on all areas disturbed by mining. At present, vegetation in the project area exists on a wide range of soil types. While reclaimed soils would not necessarily resemble the original soil types, the abundance of rainfall is expected to facilitate the rapid reestablishment of

Table 4-23. Vegetation Disturbance by Alternative (acres)

General Vegetation Type	Alternative A	Alternative B	Alternative C	Alternative D
Hemlock/Spruce Forest	44.1	61.2	62.0	64.0
Hemlock Forest	124.2	75.7	76.0	78.0
Low Sites (mixed conifer, muskeg and forb/grass/sedge)	102.9	108.3	110.0	123.0
Muskeg Forest	0.8	0	0	0
Recurrent Slide Zones (alder)	5.3	3.4	3.4	3.4
Recurrent Snowslide Zone	0	0.5	0.5	0.5
Alpine	1.1	1.1	1.1	1.1
Brush	3.6	0	0	0
Total	282.0	250.2	253.0	270.0

Source: ACZ, 1991a.

vegetation on stabilized reclaimed areas. Vegetation communities should be developed in a manner similar to the revegetation of areas clear cut for timber in this region. Long-term effects on vegetation resources are not anticipated.

Sensitive Species

Platanthera chorisiana, a Forest Service Region 10 sensitive species, is known to occur within the study area. Since the species occurs in habitats that include mixed conifers and muskeg, it is possible that construction of project facilities could impact some individuals on the site. The potential for impacts from construction of the tailings impoundment (Alternative A) would be lower than the potential for impacts from construction of the DTF (Alternatives B through D), due to the species' habitat preferences.

Timber

Table 4-24 lists the estimated volume of timber that would be removed from the site under each alternative. Timber would be harvested prior to initiation of mining activities rather than treated as slash material. The values presented in Table 4-24 differ from those presented in the FEIS and were calculated using the high end of projected timber production ranges established for particular forest types in the Tongass National Forest (ACZ, 1991a). Timber harvested as a result of any of the alternatives would not change the amount of marketable timber in the region because the current LUD II designation on the site was not calculated as part of the allowable sale quantity for the Tongass National Forest.

Old Growth Forest

Timber harvesting activities on Federal forest lands must address the presence of old-growth forest. The acres presented in Table 4-25 were derived by overlaying areas mapped as old growth within the Tongass National Forest with the footprint of each alternative. The results indicate the extent of potential impact to old growth timber.

Table 4-24. Timber Removed by Alternative

Alternative	Vegetation Impacted (acres)	Timber Removed (million board feet)
A (No Action)	164.9	3.30
B (Proposed Action)	137.0	2.68
C (Marine Discharge)	138.0	2.71
D (Modified DTF Design)	137.6	2.70

Table 4-25. Old Growth Forest Removed by Alternative

Alternative	Disturbance (acres)
A (No Action)	86.5
B (Proposed Action)	71.6
C (Marine Discharge)	72.7
D (Modified DTF Design)	73.2

The proposed revisions to the Tongass Land Management Plan would designate an area around Independence Lake as a Habitat Conservation Area (HCA). An HCA is a contiguous unit of a particular habitat type, usually old growth, to be maintained or managed to perpetuate that habitat, generally by protecting it from future alteration. This HCA is located north of the Kensington Gold Project and would be outside the area of disturbance. Consequently, this HCA would be protected from alteration.

Cumulative Effects

The Kensington Gold Project could contribute to some cumulative effects to vegetation resources within the region. Under each alternative, reclamation would focus on reestablishing vegetation that would support the pre-mining land use of wildlife habitat and recreation. It is likely, however, that vegetation communities established upon reclamation of the tailings disposal facilities (all alternatives) would not resemble the communities currently occupying these sites.

Summary

Each alternative would affect vegetation resources in the project area. Alternative A would disturb 282 acres, Alternative B would disturb 250 acres, Alternative C would disturb 253 acres, and alternative D would disturb 270 acres. Disturbed lands would be revegetated upon closure of the mine, which would start the process of succession, thereby allowing natural vegetation communities to become reestablished. Timber would be harvested from the site prior to the start of mining activities and would be expected to regenerate following reclamation. The amount of old growth on the site is limited due to historic mining activities. None of the alternatives would result in the loss of more than 90 acres of old growth.

4.8.3 Wetlands

Each alternative would affect wetlands, which is an important resource in the project area. Activities that could affect wetlands are subject to various regulations. Section 404 of the Clean Water Act governs any activity that would result in the placement of dredged or fill material into a wetland. The Corps of Engineers permits activities subject to Section 404 (see Appendix A). Prior to permit issuance, the project must demonstrate compliance with the Section 404 (b)(1) guidelines (see Appendix A), as described in a memorandum of agreement between the Corps of Engineers and EPA. The guidelines require that the parties responsible for projects in jurisdictional wetlands 1) avoid impacts, 2) minimize impacts, and/or 3) provide compensation for unavoidable impacts (Section 404(b)(1) guidelines).

Avoidance and minimization of impacts are components of project design and operation. The predominance of wetlands within Southeast Alaska, particularly at elevations where construction of mine-related facilities would be possible, precludes avoidance of all wetland impacts. Impacts could be minimized by designing facilities to fit within the smallest possible disturbance footprint, constructing facilities outside of wetlands to the extent possible, and employing Forest Service BMPs during construction to minimize additional direct or indirect impacts.

The Corps of Engineers would determine the extent of compensatory mitigation based on the project as a whole and comments from the public and other agencies. The Corps of Engineers would finalize compensatory mitigation requirements, if any, upon issuance of the Section 404 permit.

This section discusses the potential impacts to wetlands using net loss as the indicator. In assessing the potential impacts, both direct and indirect impacts were considered.

Effects of Alternative A (No Action)

Alternative A would affect 271 acres of wetlands during operation of the project. The development of the process area, tailings impoundment, diversions, and roads would produce both direct and indirect impacts. Upon closure, wetlands would be reestablished at the site to the extent possible, although 51 acres of wetlands filled during construction of the tailings dam would be permanently lost.

The extent of direct wetland loss was determined by overlaying the jurisdictional wetland delineation map (Corps Application) with the footprint of Alternative A (Coeur, 1996c). The affected acreage would be concentrated in the forested wetlands that form the riparian habitat along the main channel of Sherman Creek. Palustrine emergent wetlands (muskeg) would be affected to a lesser extent. Important functions and value provided by these wetlands include moderate to high values for surface hydrologic control, low to high values for sediment retention, moderate values for wildlife diversity, and high to moderate values for riparian support (ACZ, 1991a). The ability of wetlands within the disturbed areas to perform these functions and values would be lost or reduced during the operation of the mine. Other direct impacts include deposition of construction-related sediment into wetlands and storm water discharges. Although

these activities might not eliminate the presence of a particular wetland, they could impair the ability of the wetland to perform particular functions at a given level. This situation should not occur if the outfalls were operated as permitted and Forest Service and EPA BMPs used, as described in Section 4.3.

Indirect impacts could include alterations of site hydrology and long-term changes in the ability of wetlands to perform particular functions. Construction activities could modify surface and subsurface flow, which could result in changes to downgradient wetlands. In these cases, alterations to wetland hydrology probably would be localized. Most of the dominant plant species within the site's wetlands are facultative species (i.e., they occur equally in wetlands and uplands) (ACZ, 1991a). Because these species are adapted to both wet and dry conditions, localized changes in hydrology probably would not affect overall species composition significantly. Other indirect impacts could result from direct impacts. Any indirect impacts to wetland hydrology would be expected to be only minor and limited in duration, therefore.

Upon final closure, scrub-shrub or forested wetlands could be established on the reclaimed tailings impoundment. The design of the tailings dam would preclude the development of wetlands and result in the permanent loss of 51 acres. Final reclamation would include regrading the site to approximate natural contours, which should support the redevelopment of much of the forested wetlands impacted during operations. Page 4-58 of the FEIS indicates that previously disturbed wetland areas within the Sherman Creek drainage had reestablished themselves, for the most part, to the extent of meeting the criteria for jurisdictional wetlands. This situation lends support to the concept that wetlands likely would be reestablished successfully following final reclamation.

Effects Common to Alternatives B Through D

Alternatives B through D each would result in a similar extent of direct loss of wetlands at the site. These losses would not affect riparian wetlands along Sherman and Ivanhoe creeks as much as Alternative A, however. The development of the process area, the DTF, borrow areas, diversions, and roads would have both direct and indirect impacts. The primary difference among all alternatives is the type of wetlands that would be impacted during the development of the tailings disposal facilities. The DTF proposed under Alternatives B through D would mainly affect palustrine emergent and scrub-shrub wetlands (USFWS, 1979). As mentioned previously, the tailings impoundment proposed under Alternative A primarily would impact forested wetlands. Both permanent and temporary impacts to wetlands are anticipated under Alternatives B through D. Permanent losses would include portions of the process area and the DTF.

Construction of roads and the process area would directly impact forested wetlands within the Sherman Creek drainage. Construction of the DTF and, to a lesser extent, the borrow areas, would affect palustrine scrub-shrub wetlands. Important functions provided by these wetlands include moderate to high values for surface hydrologic control, low to high values for sediment retention, and moderate to high values for riparian support. The ability of wetlands within the disturbed areas to perform these functions and values would be lost or reduced during the operation of the mine. Impacts resulting from construction of the roads and process area

would be temporary for the most part, because final reclamation would restore drainage patterns and approximate original contours where possible. Impacts from permitted storm water discharges should not produce significant changes in wetland function if the outfalls were operated as permitted and Forest Service BMPs used, as described in Section 4.3.

Indirect impacts could include alterations of site hydrology, changes in wetland type, and long-term changes in the ability of the wetlands to perform particular functions. Construction activities could modify surface and subsurface flow, which could affect downgradient wetlands. In these cases, alterations to wetland hydrology probably would be localized. Most of the dominant plant species within the site's wetlands are facultative species (i.e., they occur equally in wetlands and uplands). Because these species are adapted to both wet and dry conditions, localized changes in hydrology probably would not affect overall species composition significantly. Therefore, this type of impact probably would not change the appearance or function of the wetland. Any indirect impacts to wetland hydrology, therefore, are not expected to be significant.

Final reclamation would include regrading the site to approximate natural contours, which should support the redevelopment of forested wetlands impacted during operations. The palustrine scrub-shrub wetlands impacted by the DTF would be lost, because the configuration of the DTF would preclude reestablishment of wetlands on the site. Forested wetlands filled during construction of the process area also would be lost permanently. The palustrine scrub-shrub wetlands excavated in the development of the borrow areas would be reclaimed as bodies of open water. These shallow aquatic beds would provide similar functions and values in the post mining landscape. The sediment ponds also would be left as open water and perform similarly in the post-mining landscape. These reconstructed wetlands likely would fill with sediment and organic material over time and eventually resemble palustrine emergent or scrub-shrub wetlands.

Cumulative Effects

Considering the prevalence of wetlands in the region, other reasonably foreseeable projects (i.e., the Lace River Hydroelectric Project, Goldbelt's proposed Echo Cove development, the Juneau Access Project, and the Jualin Project) could conceivably impact wetlands within the region. One alignment under consideration for the Juneau Access Project would route the road adjacent to the project area; unavoidable impacts associated with that project could also affect wetlands within the Kensington Gold Project site. The other projects could result in the loss of wetlands within the greater area surrounding the Kensington Gold Project site.

Each of the projects would have to comply with Section 404 permitting requirements to avoid, minimize, and compensate for unavoidable impacts. Wetlands are likely to dominate the areas available for construction, as in the case of the Kensington Gold Project site. In these cases, compensatory mitigation may be difficult to accomplish because of the lack of suitable sites for mitigation. If implemented, therefore, these projects could produce a net loss of wetlands within the area.

Summary

The primary difference among the type and extent of wetlands disturbed is between Alternative A and the other alternatives. Table 4-26 presents both short-term (i.e., life of the project) and long-term (i.e., beyond the life of the project) wetland disturbance. Alternative A would disturb 271 acres of wetlands, including palustrine forested wetlands adjacent to Sherman Creek. The loss of these wetlands would correspond to a loss in the functions they provide, including sediment trapping and surface hydrologic control. These functions contribute to the maintenance of the riparian corridor and enhance the downstream fishery by reducing the magnitude of peak flows associated with flood stages, sustaining stream flows during dry seasons, reducing bank erosion and channel scour, and reducing the amount of sediments moving downstream (ACZ, 1991a; Adamus Resource Assessment, 1987). Following closure, palustrine wetlands would be allowed to develop on the reclaimed tailings impoundment, although the physical alteration of the reclaimed channel would preclude the complete restoration of the forested wetlands.

Alternatives B through D each would disturb between 243 and 262 acres of wetlands during operation. While these alternatives would also result in the loss of forested wetlands, much of the impact would be to palustrine scrub-shrub wetlands located off the main channel of Sherman Creek. Although these wetlands provide important functions, including sediment trapping and nutrient transformation, they are associated with upland areas and are removed from Sherman Creek (ACZ, 1991a; Adamus Resource Assessment, 1987). Upon closure, the DTF would be reclaimed as an upland, which would result in the permanent loss of between 113 (Alternatives B and C) and 130 (Alternative D) acres. The final configuration of the process area would also result in the permanent loss of 34 wetland acres. These upland areas would support the development of Sitka spruce forest, a habitat type not currently represented at the site. In addition, approximately 55 acres of open water would be left at the site as reclamation of the borrow areas and sedimentation ponds. These aquatic habitats would support wetlands along their fringes and provide functions and value similar to those provided by the palustrine wetlands that presently occupy the site. Although wetlands would be permanently lost at the site, the upland and aquatic habitat provided following reclamation would increase habitat diversity.

Table 4-26. Direct Wetland Loss by Alternative

Alternative	Wetland Disturbance (acres)	
	Short-Term	Long-Term
A (No Action)	271	51
B (Proposed Action)	243	147
C (Marine Discharge)	246	147
D (Modified DTF Design)	262	164

4.9 CULTURAL RESOURCES

The scoping process did not identify potential effects on cultural resources as an issue. The actions analyzed in this Draft SEIS are the same substantively to those analyzed in the FEIS for cultural resources. Alternative A in this Draft SEIS corresponds to Alternative F in the FEIS; Alternatives B through D correspond to the area analyzed under Alternative E (Site B) in the FEIS. The FEIS did not identify any potential significant impacts to cultural resources for Alternatives E and F. Additional literature search, consultation with Native American Tribes, ground truthing, and testing would be required to confirm the presence or absence of cultural resources at some locations within the project area.

4.10 VISUAL RESOURCES

Activities occurring within the Tongass National Forest are permitted on the basis of a visual quality objective (VQO), which is used as the indicator for evaluating potential impacts to visual resources, for a specific area. The applicable VQO is determined based upon the scenic variety in the landscape, the distance between the landscape and the people viewing it, and the importance of the scenic quality to the people viewing it. Pages 3-70 through 3-74 of the FEIS provide more specific information on defining VQOs.

The study area is primarily seen in the middleground from the Alaska Marine Highway and cruise ship routes between Juneau, Skagway, and Haines. Viewers are typically 1 to 2 miles offshore. Commuter airline routes between Juneau, Skagway, and Haines also follow Lynn Canal and provide air passengers with brief overhead views of the project site. The landscape can be broken into three general landscape components: the water; the lower rounded forested foothills on the canal banks and islands; and the steep, often ice-clad taller peaks behind the foothills to the east and west of Lynn Canal.

4.10.1 Effects of Alternative A (No Action)

Page 4-88 of the FEIS discusses the potential impacts on visual resources associated with Alternative A (Alternative F in the FEIS).

4.10.2 Effects Common to Alternatives B Through D

The potential effects from Alternatives B through D would be the same for each alternative for all practical purposes. The use of pipelines under Alternatives C and D would not reduce the width of the roads. Changes to the DTF proposed as part of Alternative D would not change the overall size of the till borrow pits, and the larger footprint would not substantially change the visual impact of the facility. This section, therefore, describes the potential impacts to visual resources for all three alternatives during operations and after closure. Appendix B presents excerpts from a draft reclamation plan.

Facilities

Structures

Alternatives B through D would create additional disturbances in the Comet Beach area. A temporary personnel camp would be constructed adjacent to the water and become a storage area for ore containers upon completion of the permanent camp. In addition, the helicopter landing area and hangar would be located fronting on Comet Beach.

The FEIS described the impacts from the personnel camp and refining operations as being screened by the approved tailings dam. Alternatives B through D include a DTF, which would be located southeast of the Comet Beach structures. The process area facilities that would be hidden under Alternative A, therefore, would be visible under Alternatives B through D. The use of containers to ship the ore offsite for processing would create an additional impact. The impacts from these structures would be in an area with a VQO of Partial Retention. Given the distance from Lynn Canal and the application of mitigation measures as outlined in Chapter 2, the impact should not be substantial. The containers would not be made of a highly reflective material and, if possible, their color would blend in with the surroundings to minimize impacts (i.e., dark green or brown).

Borrow Pits

Under Alternatives B through D, four borrow pits would be used: two near the processing area and two on a slope facing Lynn Canal. The till borrow pits would be located in an area with a VQO of Partial Retention. The two facing directly onto Lynn Canal represent a substantial change from the FEIS. These pits would be visible from Lynn Canal. The use of mitigation, such as constructing and planting benches along the side walls, should diminish the visual impacts. Given the nature of the material, however, the pits could "unravel," creating a greater impact that could not be mitigated.

It is unlikely that these pits would conform with the VQO during operation. With revegetation and slope stabilization, however, the area could be returned to a condition within the Partial Retention objective.

Dry Tailings Facility

The DTF would be a substantial change to the existing landscape. With appropriate contour design, the finished product could replicate the existing landforms and conform to the VQO of Partial Retention. The operator would grade and seed the facility concurrently with construction, which would assist in mitigating the visual impacts. Plantings should replicate as closely as possible typical Southeast Alaska vegetation patterns (e.g., Sitka spruce and hemlock with an understory of blueberry and deer cabbage).

Roads

Under Alternatives B through D, a longer road segment would be visible compared to Alternative A because the tailings dam would not screen the roadway. Also, the lack of the dam

would no longer present a more glaring contrast to draw viewers' attention away from the road. The color of existing road surface materials is a light gray, which contrasts with the surrounding landscape, making it difficult to hide the road. End-hauling slash and seeding side slopes should diminish the impacts, however. During closure, roads would be ripped, contoured to blend with surrounding terrain, and seeded to accelerate the return of naturally occurring vegetation.

Emissions

The change in fuel from LPG under Alternative A to diesel under Alternatives B through D would increase the amount of particulate discharge. Section 4.1 discusses the potential visual impacts from emissions from the generators.

4.10.3 Cumulative Effects

The only existing or reasonably forseeable projects for the area that, in combination with the Kensington Gold Project, could cumulatively affect visual resources in the area are the Jualin Project and the Juneau access road. The Jualin Project is located in a different viewshed and would not create additional visual impacts observable from the Kensington Gold Project viewing area. If Kensington facilities were also used to support the Jualin Project, additional effects on visibility could occur. These impacts cannot be evaluated until a specific proposal for the Jualin Project is developed and submitted to the Forest Service. An extension in project life would not substantively affect the magnitude of project impacts.

One of the current considerations for the location of the Juneau access road would place the road adjacent to the DTF. This road location would place observers so near the project that it would be impossible for the facility to meet any VQO during operation and until substantial revegetation had occurred.

4.10.4 Summary

The tailings dam proposed under Alternative A and the DTF under Alternatives B through D would be visible from vessels in Lynn Canal, as well as from airplanes and helicopters. The tailings dam would screen visual impacts resulting from process area activities from observers in Lynn Canal; the DTF would not. Under Alternatives B through D, impacts would specifically be expected from the till borrow area. The DTF would likely be mitigated to a lower level of impact following successful reclamation compared to the tailings dam. Overall, the potential impacts from all of the alternatives for the Kensington Gold Project would result in a similar level of disturbance to visual resources.

4.11 SOCIOECONOMIC RESOURCES

This section describes the potential effects of the project alternatives on socioeconomic resources using the following indicators:

- Population
- Employment and payroll (both direct and indirect effects)
- Housing
- School enrollment
- Health and social services
- Public safety
- Public utilities
- Revenues and expenditures.

Population growth can be projected by examining employment trends, because a close relationship has traditionally existed between changes in employment and changes in population. State government employment has strongly influenced Juneau's economy since statehood. At present, about half the local economy depends either directly or indirectly on the State government. Employment projections for the next decade or more call for modest reductions in State government employment. These would be offset and perhaps exceeded by increases in private sector employment. Projected increases in private sector employment are based largely on increases in cruise line ship capacity, numbers of port calls, and passenger arrivals. Capacity increases of cruise ship lines are programmed at 7 percent per year through 1999 (Alaska Visitors Association, 1996).

Based on 1991 to 1995 historical data, net in-migration likely would be slightly positive through the end of the century, with increases estimated at 0.19 percent average annual rate of growth (AARG). Further, based on 1991 to 1995 historical data, a natural increase is expected to follow recent historical patterns also, rising at a decreasing rate from 1.2 percent AARG in 1997 to 1.0 percent AARG in 1999. The current population for the City and Borough of Juneau is estimated by the CBJ Community Development Department at 30,209 in 1996. Using this figure as the base, the population of the city and borough is projected to increase to 31,730 in 2000 and 34,091 in 2013.

Employment multipliers aide economists in projecting the potential effects that basic economic activity, including mining and manufacturing, could have on a community. An employment multiplier estimates the number of new jobs in service or other sectors that could result from each basic industry job created. The economic multiplier for the City and Borough of Juneau is estimated at 1.75 (i.e., for every 100 new basic industry jobs in the community, 75 support and service sector jobs would also be created).

Employment multipliers are developed based on the availability of goods and services required by the industry to operate. They include the portion of the total payroll that is projected to be actually spent in the area. The lack of manufacturing industries in the area results in a reliance on purchases of goods and services from other regions. The more dollars spent on goods and services obtained outside the local economy, the smaller the size of the multiplier and the associated benefits to spin-off industries. Consequently, the employment multiplier for Juneau is smaller than that of metropolitan areas with greater industrial capacity.

Executive Order 12898 focuses on environmental justice by requiring Federal agencies to identify and address disproportionately high and adverse human health or environmental effects

of their activities on minority and low-income populations. The project area is not located within an area where it could disproportionately affect minority or low-income populations. Compliance with Executive Order 12898 is considered satisfied for the purpose of the Draft SEIS.

4.11.1 Effects of Alternative A (No Action)

City and Borough of Juneau

Population Effects

Under Alternative A, the peak operations population would be 346 persons or about 36 percent greater than estimated for Alternative B. The operator would build a 250-person camp to accommodate construction workers at the mine, which would substantially reduce the number of construction workers and dependents relocating to the community during the construction phase of the project. Most construction workers, especially single or unaccompanied workers, probably would reside at the construction work camp and, during periods not working, return to the location of permanent residence. It is anticipated that 20 percent of construction workers would be accompanied by family members and, consequently, would establish residences in Juneau. A higher proportion of production workers would be accompanied by family members and, because they would they would have the opportunity for long-term employment during the operational phase, it is assumed that 75 to 80 percent would choose to reside in Juneau. All operator management staff are expected to reside in the community. Other workers would likely reside in Haines, Skagway, and other Southeast Alaskan communities.

The average household size for in-migrating production workers is estimated at 2.5, based on 1996 estimates for Juneau (CBJ Community Development, 1996). This translates to a family size of 2.75 for married workers. Because of lower family accompaniment rates, construction worker household size is estimated at 1.4 persons per household. In addition to workers and dependents, a number of unemployed job seekers likely would be attracted to the area. In total, the Kensington Gold Project would increase Juneau's population by approximately 894 people when the mine is in full operation. Table 4-27 compares the annual estimates of mine-related population for Alternative A to the baseline population estimated for the City and Borough of Juneau (CBJ).

Direct Employment and Payroll Effects

The development schedule for Alternative A calls for three phases over a 16-year period. The construction of surface and underground facilities is planned for the first 2 years, followed by an operational phase of 12 years and a 2-year period of decommissioning. Table 4-28 presents annual estimates of direct, indirect/induced, and total employment for each year of the project.

Alternative A would directly increase employment by 92 workers compared to Alternatives B through D. Similarly, employment during the construction phase would be higher

Table 4-27. Kensington Gold Project Population Effects Under Alternative A

Year	Baseline Population	Kensington Gold Project Population	Percent of Baseline Population
1997	30,605	501	1.63
1998	30,983	606	1.95
1999	31,352	836	2.67
2000	31,540	903	2.86
2001	31,730	901	2.83
2002	31,920	902	2.82
2003	32,112	898	2.79
2004	32,304	895	2.77
2005	32,498	901	2.77
2006	32,693	894	2.73
2007	32,889	894	2.71
2008	33,087	894	2.70
2009	33,285	894	2.68
2010	33,485	898	2.68
2011	33,686	394	1.16
2012	33,888	131	0.38
2013	34,091	–	0
2014	34,292	–	0

Table 4-28. Kensington Gold Project Employment Under Alternative A

Year	Direct Employment	Indirect Employment	Total Employment
1997	289	96	385
1998	286	147	433
1999	335	227	562
2000	347	253	600
2001	345	252	597
2002	345	252	597
2003	346	253	599
2004	343	252	595
2005	341	252	593
2006	345	252	597
2007	340	252	592
2008	340	252	592
2009	340	252	592
2011	343	252	595
2011	150	111	262
2012	50	37	87
2013	0	0	0

under Alternative A (575 person years versus 502 person years for Alternatives B through D). The associated increase in payroll during the 12-year operations phase under Alternative A would be about $4.3 million per annum. The increase in payroll during the 2-year construction phase would amount to about $2.3 million overall.

Indirect Employment and Payroll Effects

Local purchase of supplies and services, as well as the respending of earnings by direct construction worker households, related to the Kensington Gold Project would result in an increase in indirect/induced employment during operations of about 65 workers more than Alternatives B through D. During the construction phase, indirect/induced employment under Alternative A also would be higher than Alternatives B through D by about 54 workers. Indirect earnings would increase by approximately $2.5 million annually during operations and by approximately $1.4 million during the 2-year construction phase.

Housing Effects

The extremely low vacancy rate and generally tight housing market indicated for the City and Borough of Juneau would be exacerbated by Alternative A. The total requirement for housing would increase to approximately 96 and 143 units during the first 2 years of construction, respectively, and from 217 to 292 units during the 12 years of operations. The project-related demand resulting from the Alternative A would exceed the total supply of vacant housing units in 1996; however, baseline population growth during the next 5 years also would readily absorb existing vacancies. Thus, implementation of Alternative A would increase pressure on the community to address the pre-existing shortage in housing availability.

School Enrollment

Alternative A would result in additional pupils for the Juneau School District. If mine-related enrollment followed the existing pattern in enrollment, by year 3 of the Kensington Gold Project, 83 new pupils would be added in grades K through 5, 43 in middle school, and 54 in the high school grades.

The additional enrollment associated with the Kensington Gold Project would not result in capacity problems at the elementary grade level. At present, the middle school experiences modest capacity deficiencies (48 spaces). With the mine-related enrollment under Alternative A, however, the deficits would increase by about 35 spaces during operations. The capacity problem could be addressed by using portables as is being done within the school system. The current deficit in high school classroom space is 453 spaces and would rise to 500 spaces under baseline population conditions forecast to 2013. The mine-related enrollment under Alternative A would exacerbate this condition by adding another 53 pupils during the operations phase.

Health and Social Services

Under Alternative A, the operator would provide emergency medical equipment at the mine and would contract with a local group to provide ambulance service to the site.

Bartlett Memorial Hospital would experience greater increases in admissions due to accidents and illnesses occurring in the mine-related population under the Alternative A, but the increases would not affect the hospital's ability to accommodate in-patient needs.

The City and Borough of Juneau, U.S. Indian Health Service, and Lakeside Recovery Corporation provide substance abuse services in the Juneau area. If the age and sex ratios of the mining population were the same as current Juneau ratios, then there would be no disproportionate increase in the demand for chemical dependency services. Alcohol and drugs would not be allowed at the personnel camp, and individuals applying for work would be tested for alcohol and drugs. The support sector population probably would require treatment at about the average rate in the Juneau population and, because of the population increase associated with Alternative A, the numbers requiring treatment would be greater than currently exist.

The Juneau Alliance for the Mentally Ill, the CBJ's Juneau Mental Health Clinic, and private sector organizations provide mental health services. Limited mental health services are available to Alaska Natives through the southeast Alaska Regional Health Corporation. The Mental Health Clinic has a long waiting list currently, but this list could be reduced if the clinic were staffed fully. Implementation of Alternative A would increase the demand placed on mental health services.

Public Safety

Under Alternative A, police services would increase by a modest amount. The fire department likely would provide fire response and EMS/MEDIVAC services under a cost reimbursement program. The increase in population under Alternative A would not create a greater need for additional fire department personnel or equipment. Although more homes would be occupied and constructed, the fire department has sufficient staff and equipment to meet the potential increase in demand estimated for Alternative A.

Public Utilities

Alternative A would not draw upon the water utilities of the City and Borough of Juneau, because an onsite water supply would be established. Population growth associated with development of the mine would result in additional residential and commercial demand for water from the municipal system. According to municipal utility officials, the downtown and valley areas have water capacity in excess of demand and sufficient to handle any Kensington Gold-related service demand.

The operator would install an onsite wastewater treatment facility for its operations that would be separate from any facilities within the CBJ. New residential development is expected to occur primarily in the Mendenhall Valley and North Douglas where the most land is available. The Mendenhall Valley treatment plant is operating at about 25 percent of capacity and can handle increased residential loads. Some additional commercial development, primarily in the downtown area, likely would occur as a result of the projected population growth. The Juneau-Douglas treatment plant has adequate treatment capacity available for additional commercial customers, according to CBJ utility officials.

An onsite incinerator is planned at the mine to dispose of burnable materials. A licensed contractor would haul non-burnable materials from the site to other locations for disposal at permitted facilities.

Electric power for mine construction and operation would be generated onsite, and mining operations would not directly impact power consumption or electric rates. Current electrical demand is about 291 million kilowatts. Alaska Electric, Light and Power and Alaska Power Authority generated a total of 319.3 million kilowatts in 1995 for the Juneau area. The population growth attributable to the Kensington Gold Project would increase total demand only marginally.

Effects on CBJ Revenues and Expenditures

The proposed development under Alternative A would result in increases in both revenues and expenditures for the City and Borough of Juneau compared to Alternative B. One major problem for municipal finance is related to the low property tax mill rate applied by the municipality in roadless areas. Reductions on property taxes collected from these areas could result in fiscal deficits for the City and Borough of Juneau during most of the mine life, while the assessed value of the mine would be high. In addition, funding of community services would add to the imbalance between revenues and expenditures.

Property tax revenues would increase due to the value of new residential and commercial construction, as well as the value of the mine and its improvements. Property is assumed to be assessed at its market value or construction cost in the year it is built, but revenues are not received until the following year. This does not include property tax revenues generated from the rise in property values associated with increased demand.

Sales tax revenues would accrue to the CBJ from supplies purchased locally during the construction and operation of the mine. As mentioned previously, only 5 percent of the annual non-personnel operating budget is estimated to be spent locally. The current tax rate of 4 percent, including any voter-approved increases (or decreases), would be applied to this amount to calculate the total CBJ revenue contribution. The sales tax revenue would also be collected from the personal expenditures by mine-related households. Enterprise funds from sewer and water utilities are supported by user fees and probably would not be impacted fiscally by the mine project.

Revenues from State sources, such as municipal assistance, revenue sharing, health and social service grants, and SSR/SOADA chemical dependency grants, would increase in proportion to population and, thus, would rise as a result of mine-related population growth, as well as property valuation increases.

No additional capital facilities projects have been identified for the City and Borough of Juneau that would be attributable to the Kensington Gold Project under Alternative A when compared to Alternative B. Specific staffing needs might be greater for permitting and oversight under Alternative A, however, because of the development of the tailings impoundment, which

would add to the workload and related costs for the CBJ Community Development Department and, perhaps, the Engineering and Public Works.

More generally, the City and Borough of Juneau is anticipated to experience modest deficits, primarily owing to the anomaly of State foundation support, which subtracts revenues generated from property taxes collected from the first four mills of the local property tax levy. In the case of a large mine project located in a roadless area, where the total levy is about 5 mills, the major share of property taxes collected would offset the State's school foundation support level, thereby resulting in substantially lower revenues to the school district than would occur in an urban service area where the millage is substantially higher (currently 12.49 mills). This could result in a greater deficit between revenues and expenditures experienced by the City and Borough of Juneau under Alternative A compared to Alternative B.

City of Haines, Borough of Haines, and City of Skagway

Under Alternative A, the potential socioeconomic impacts on the City of Haines, Borough of Haines, and City of Skagway compared to Alternative B would be modest and insignificant.

4.11.2 Effects Common to Alternatives B Through D

There is little variation in socioeconomic effects among Alternatives B through D because the primary differences are related to the physical design of mine operations. The following discussion, therefore, presents the potential effects from implementing any of these alternatives.

City and Borough of Juneau

Population Effects

Under Alternatives B through D, the peak population during the operational phase would be 253 persons; total employment at the site would peak at approximately 338 in the second year of construction. Table 4-29 presents the annual estimates of mine-related population for Alternatives B through D, as well as the baseline population estimated for the City and Borough of Juneau.

The operator would build a 250-person camp to accommodate construction workers under Alternatives B through D, substantially reducing the number of construction workers and dependents relocating to the community during the first 2 years of the project. As discussed previously, 75 to 80 percent of the production workers would choose to reside in Juneau and be accompanied by family members. All operator management staff probably would reside in the community. In addition to workers and dependents, a number of unemployed job seekers likely would be attracted to the area. In total, implementation of Alternative B, C, or D would increase

Table 4-29. Kensington Gold Project Population Effects Under Alternatives B Through D

Year	Baseline Population	Kensington Gold Project Population	Percent of Baseline Population
1997	30,605	242	0.79
1998	30,983	618	2.00
1999	31,352	665	2.12
2000	31,540	665	2.10
2001	31,730	665	2.09
2002	31,920	665	2.08
2003	32,112	665	2.10
2004	32,304	665	2.05
2005	32,498	665	2.04
2006	32,693	665	2.03
2007	32,889	665	2.02
2008	33,087	665	2.00
2009	33,285	263	0.79
2010	33,485	263	0.79
2011	33,686	–	0
2012	33,888	–	0

Juneau's population by approximately 665 people with the mine in full production. Table 4-29 compares the annual estimates of mine-related population under Alternatives B through D to the baseline population estimated for the City and Borough of Juneau.

As shown in the table, mine development contributes modestly to population growth in the City and Borough of Juneau during all years of the project. By 1999, an additional 1,996 people would be expected to reside in the community with modest population growth through 2008, at which point a total population increase of 3,543 persons above 1996 levels would be achieved. Shutdown of the mine would begin in 2009 with 586 people projected to out-migrate from the area. An additional 70 direct workers and associated population for a total of 263 people probably would out-migrate following the final 2 years of decommissioning and reclamation. This amounts to Juneau losing 2 percent of its population over a 3-year period, which is a modest impact. Upon closure of the mine, approximately 3,882 additional people are projected to reside in Juneau compared to the 1996 population.

Direct Employment and Payroll Effects

Alternatives B through D would result in increased employment and income to the Juneau area. The proposed development is scheduled to take place in three phases over a period of 15 to 16 years. Surface and underground facilities would be constructed during the first 2 years, followed by an operational phase of 10 years and a 2-year period of reclamation and decommissioning. Table 4-30 presents annual employment estimates for the Kensington Gold Project under Alternatives B through D.

The direct construction workforce includes both construction and production workers employed by the operator. The average workforce amounts to 164 workers during the first year

Table 4-30. Kensington Gold Project Employment Under Alternatives B Through D

Year	Direct Employment	Indirect Employment	Total Employment
1997	164	35	199
1998	338	128	466
1999	253	187	440
2000	253	187	440
2001	253	187	440
2002	253	187	440
2003	253	187	440
2004	253	187	440
2005	253	187	440
2006	253	187	440
2007	253	187	440
2008	253	187	440
2009	30	22	52
2010	30	22	52
2011	100	74	174
2012	100	74	174
2013	0	0	0

of construction and 338 workers during the second year of construction. The average wage for construction workers is estimated at $61,667, based on $26.13 per hour, 47 hours per week and 50 work weeks per year (Alaska Department of Labor, 1996). Production worker wages are estimated at $45,000 per annum, based on operator planning data. Total wage payments during the construction phase of the project are estimated at $28.2 million; annual wage payments during the operational phase is projected to be approximately $11.3 million. These estimates do not include onsite living expenses paid for by the operator.

Indirect Employment and Payroll Effects

Outlays for construction of the mine are estimated at $190 million, and annual non-personnel operating costs are likely to exceed $20 million. The McDowell Group (1990b) estimated that only 5 percent of the materials and subcontracted labor included in these figures would come from local sources. This translates into $9.5 million of purchases during the 2-year construction phase, followed by annual expenditures of $1.0 million during operation. Although a large portion of the construction and operating budget would not be captured by the local economy, spending by mine workers and family members on personal consumption would contribute to local economic activity.

Applying the employment multiplier of 1.75 to project induced/indirect employment created by the mine results in a peak of 187 induced/indirect jobs during the first year of mine operations. Employment gains would be realized in trade and service industries and finance, insurance, and real estate businesses, among others, as the effect of the mining operations

stimulated the economy. Additional local government jobs also would be required to respond to a higher level of demand for public services.

Housing Effects

Vacancy rates provide an indication of the potential for housing development and an estimate of the number of housing units available at a particular point in time. The most recent vacancy rates for Juneau area (November 1996) are as follows: single family dwellings–1.69 percent, multifamily dwellings–3.25 percent, and mobile homes–0.96 percent. These percentages translate to approximately 220 vacant housing units available for new residents. The vacancy rate for all housing has declined from a high of 10 percent in 1986 to the current rate of 1.9 percent.

The extremely low vacancy rate is indicative of a very tight housing market. Consequently, if all of the housing demand generated by development of the Kensington Gold Project is assumed to translate into the need for additional housing units, the total requirement would amount to 36 and 126 units during the first 2 years of construction, respectively, and 217 units during operations. The project-related demand would approximate the total supply of vacant housing units in 1996; however, baseline population growth during the next 5 years would easily absorb existing vacancies. Like the situation described under Alternative A, implementation of Alternative B, C, or D would increase pressure on the community to address the pre-existing shortage in housing availability.

Coeur Alaska and Goldbelt, Inc. (a Native Alaska corporation), recently announced that they have an agreement to construct 102 units of new housing in and around Juneau for use by local residents. Goldbelt would construct the housing, which could be a mix of single family and multifamily units. Coeur Alaska would provide financial assurance, and mining employees would receive priority for the purchase of the homes built under the agreement. The additional housing to be provided under the agreement would help address the housing shortages, particularly for families of in-migrating workers to the Kensington Gold. Housing needs for workers indirectly associated with the development of the mine would be more difficult to address because of the shortage of affordable housing in the area.

As a consequence of the lack of housing availability in Juneau, particularly rental units and affordable for-sale units, the increase in demand would be reflected in higher prices in the short term. Both rental rates and purchase prices would be expected to increase along with property assessments. Some in-migrating families could be forced to accept low-quality housing; existing residents might not be able to afford competitively higher housing prices, particularly for rental units.

School Enrollment

Alternatives B through D would result in additional pupils for the Juneau School District. At full production in year 3 of the Kensington Gold Project, 63 new pupils would enter grades K through 5, 30 would enter the middle school grades, and 39 the high school grades. The project-

related total of 133 pupils represents a 2.4-percent increase over the present enrollment of 5,578 students.

The additional enrollment associated with the Kensington Gold Project would not result in capacity problems at the elementary grade level. With the opening of the Riverbend Elementary School during the 1997–98 school year, available capacity (without portables) would exceed enrollment by 445 spaces without the project and by about 380 spaces with the project. The middle school currently experiences modest capacity deficiencies (48 spaces). With the mine-related enrollment, however, the deficits would increase by an estimated 20 spaces or slightly less than one standard design classroom. This capacity problem could be addressed through the use of portables. The current deficit in high school classroom space amounts to about 453 spaces and would rise to 500 spaces under baseline population conditions forecast for 2013. The mine-related enrollment would exacerbate this condition by adding another 39 pupils during the operational phase.

Health and Social Services

Under Alternatives B through D, the operator would provide emergency medical equipment at the mine and would contract with a local group to provide ambulance service to the site. Additional staffing could be required if the department would continue to provide these services throughout the life of the mine.

Bartlett Memorial Hospital would experience an increase in admissions due to accidents and illnesses occurring in the mine-related population. During 1987 through 1989, the metal mining industry incurred injuries and illnesses at 2.2 times the State's industrial average (derived from information provided by Wilson, 1990). Hospital occupancy resulting from the influx of mine employees could be expected to increase at a higher rate than that of population growth. The estimated 2- to 3-percent increase in occupancy rates as a result of the mine development would leave the hospital well below capacity limits.

Substance abuse services in Juneau are provided by the City and Borough of Juneau, the U.S. Indian Health Service, and Lakeside Recovery Corporation, a private organization. If the age and sex ratios of the mining population were the same as current Juneau ratios, then there would be no disproportionate increase in the demand for chemical dependency services. In addition, there would be no alcohol or drug use allowed at the personnel camp and applicants for work would be tested for alcohol and drugs. The support sector population would likely require treatment at about the average rate in the Juneau population. If additional substance abuse services were required, CBJ's Chemical Dependency Division would be the only entity expected to incur additional net costs because it provides charitable allowances for low-income patients.

Public Safety

For purposes of this study, the estimated 2.1 percent population increase from development of the Kensington Gold Project can be expected to require a modest increase in Juneau police services. Police protection for the mine site itself would be in the jurisdiction of the Alaska State Troopers.

The population increase under Alternatives B through D would not create a need for additional fire department personnel or equipment. Although more homes would be occupied and constructed, the fire department has sufficient staff and equipment to meet the estimated 4-percent increase in demand.

Public Utilities

Alternatives B through D would not draw upon the water utilities of the City and Borough of Juneau, because an onsite water supply would be established. Population growth associated with development of the mine would result in additional residential and commercial demand for water from the municipal system. According to municipal utility officials, the downtown and valley areas have water capacity in excess of demand and sufficient to handle any Kensington Gold-related service demand.

The operator would install an onsite wastewater treatment facility for its operations that would be separate from any facilities within the CBJ. New residential development is expected to occur primarily in the Mendenhall Valley and North Douglas where the most land is available. The Mendenhall Valley treatment plant is operating at about 25 percent of capacity and can handle increased residential loads. Some additional commercial development, primarily in the downtown area, likely would occur as a result of the projected population growth. The Juneau-Douglas treatment plant has adequate treatment capacity available for additional commercial customers, according to CBJ utility officials.

An onsite incinerator is planned at the mine to dispose of burnable materials. A licensed contractor would haul non-burnable materials from the site to other locations for disposal at permitted facilities.

Electric power for mine construction and operation would be generated onsite, and mining operations would not directly impact power consumption or electric rates. Current electrical demand is about 291 million kilowatts. Alaska Electric, Light and Power and Alaska Power Authority generated a total of 319.3 million kilowatts in 1995 for the Juneau area. The population growth attributable to the Kensington Gold Project would increase total demand only marginally.

Effects on CBJ Revenues and Expenditures

The proposed development under Alternatives B through D would increase both revenues and expenditures for the City and Borough of Juneau. Property tax revenues would increase due to the value of new residential and commercial construction, as well as the value of the mine and its improvements. The mine property would be subject to a relatively low millage rate of just more than 5 mills, compared to the current millage rate of 12.49 applied against the value of new residential and commercial construction.

Sales tax revenues would accrue to the CBJ from supplies purchased locally during the construction and operation of the mine. As mentioned previously, only 5 percent of the annual non-personnel operating budget is estimated to be spent locally. The sales tax revenue would also be collected from the personal expenditures by mine-related households. Currently, half of

sales tax revenues are committed to roads and other major capital improvements; the other half is divided between general government purposes and a reserve fund. Enterprise funds from sewer and water utilities are supported by user fees and are not likely to be impacted fiscally by the mine project.

No additional capital facilities projects have been identified for the City and Borough of Juneau that would be attributable to the Kensington Gold Project. Specific staffing could be required for permitting and oversight, which would add to workload and related costs for the CBJ Community Development Department and, perhaps, the Engineering and Public Works.

More generally, the City and Borough of Juneau is anticipated to experience modest deficits, primarily owing to the anomaly of State foundation support, as discussed previously. This would be increased by attributable debt service if a high school is funded and constructed. Even so, compared to earlier studies, the deficit is likely to be lower.

City of Haines, Borough of Haines, and City of Skagway

The operator only would provide employee transportation from a Juneau location, except that employees might have the opportunity to commute from Haines at the operator's expense. Residents of Skagway seeking employment at the mine would commute at their own expense. The operator has indicated that it would make every effort to hire locally. The company made a commitment to hire 13.8 percent of the construction workforce and 25 percent of the operations workforce from Alaska Native groups, including individuals who are so designated or their spouses. The operator agreed with Goldbelt, Inc., Klukwan, Inc., and Kake Tribal Corporation, all of which are Alaskan Native Corporations, to use them to the greatest extent possible on the mine workforce. In addition, the operator indicated that it would be amenable to providing air transportation to Juneau for the purpose of connecting with the employee shuttle operating between Juneau and the mine. It is estimated that perhaps 40 potential workers would be qualified and hired from Haines. Workers living in Haines would be shuttled to the site via Juneau.

Unemployment in Haines in November 1995 was 13.7 percent, reflecting seasonal slowdown. The Kensington Gold Project could have a significant beneficial impact on the Haines economy. Assuming that a large number of Haines residents become employed at the mine, the Haines economy would become less dependent on the tourism and fisheries industries. Spreading the economic base over more industries would help stabilize the economy.

Employment and Payroll Effects

The operator indicated that up to 40 Haines residents could be employed directly during the operational phase of the Kensington Gold Project. An additional 20 to 30 jobs could be supported by local expenditures of mine employees. The increase in total employment would be substantially less than the annual fluctuation of approximately 500 jobs represented by the difference between annual average and peak summer employment. Based on an estimated annual income of $45,000 for the mine employees and $25,000 for the indirectly supported jobs, Haines residents could earn an additional $2.58 million annually.

Only as many as seven project employees would be expected to reside in Skagway. This is less than 2 percent of the annual average employment in the community. One or two additional jobs could be supported by expenditures of earnings from the long-term mining jobs. The increase in total employment is insignificant compared to the seasonal employment pattern, which results in a summer employment level at least twice that of winter.

Because the operator made a commitment to provide transportation to workers residing in Haines, it is anticipated that up to 40 production workers would be employed from that area.

Population Related Effects

Under Alternatives B through D, only modest population growth would be expected as a result of increased employment at the Kensington Gold. It is assumed that most workers would be drawn from the existing labor pool, given existing relatively high unemployment rates. Perhaps a third of the workers taking Kensington Gold-related jobs would in-migrate or be replaced by in-migrating workers, suggesting a population increase of 58 persons (assuming 2.5 persons per worker household). This represents about a 2.5-percent increase in the present population. The minor growth expected as a result of the proposed development is dwarfed by the seasonal population growth and demand on social services regularly observed in the community.

The total population associated with the Kensington Gold Project could reach 23 people if all potential employees were new residents of Skagway. Given the present high unemployment rate in Skagway, it is more likely that the project would employ mostly current residents. The minor increase in population would not have discernible impacts on community services.

4.11.3 Cumulative Effects

Since the Gold Belt Echo Cove project is already in the development stage, the economic effects are assumed to be included in the projections provided by the City and Borough of Juneau used in the previous analyses. The Lace River Project is expected to have negligible effect on the socioeconomic environment of the area compared to the Kensington Gold Project. Construction of the Juneau access road would likely have an effect on the socioeconomics of Juneau, although it would be premature and speculative to conduct detailed analyses based on the likelihood of the project being constructed at this time.

4.12 TRANSPORTATION

4.12.1 Effects of Alternative A (No Action)

Material Offsite Transport

Under Alternative A, the potential impacts associated with transportation of materials to the Kensington site would be the same as those described on page 4-110 of the FEIS. Materials, equipment, and fuel would be transported to the Kensington site by barge to a landing site at

Comet Beach. During the operation phase, approximately 600 tons of freight, 150,000 gallons of diesel fuel, and 1 million gallons of LPG fuel would be shipped to the site monthly. This would require on average one freight barge and one LPG fuel barge per month (see the following discussion related to diesel fuel). The two additional barges per month would amount to a 1-percent increase in Lynn Canal traffic during the summer months and an 11-percent increase during the winter months. The larger percentage increase during winter months would have a minimal impact because the total number of vessels would be small.

During the commercial fishing season, the project's barge traffic could affect commercial gillnet fishing in the vicinity of Point Sherman. To minimize the potential impacts, barges would be scheduled into the site on non-fishing days to the maximum extent possible. If necessary during non-fishing days, time within the fishing areas would be minimized by having the barge approach the shoreline in a perpendicular fashion from the middle of Lynn Canal.

Under Alternative A, as well as the other alternatives, diesel fuel would be supplied to the Kensington Gold Project by regularly scheduled barges that supply diesel to facilities throughout Southeast Alaska. Three barge operators typically each have one barge per week traveling the Lynn Canal area. Each barge typically contains about 80,000 barrels of oil (3.2 million gallons). With three barges per week, about 500 million gallons of diesel fuel are transported annually in the Lynn Canal area. Under Alternative A, approximately 2 millions gallons of diesel fuel would be used annually at the mine, potentially increasing diesel transport by 0.4 percent, or less than one barge per year. Page 4-47 of the FEIS provides data on oil pollution events in Lynn Canal from 1986 through 1990. No events were associated with fuel barge sinkings or damage during this period or have occurred since then (U.S. Coast Guard, 1996). Under Alternative A, therefore, the risk associated with barge transport of fuel to the Kensington site is minimal.

The transfer of diesel fuel from the supply barge to the marine terminal at Comet Beach presents the risk of a diesel fuel spill into Lynn Canal during transfer operations. Under all alternatives, the diesel fuel would be pumped from transport containers on the barge to a storage tank at Comet Beach using a flexible transfer hose. To prevent spillage of diesel fuel during transfers, the transfer hose would be pressure tested annually and inspected for integrity prior to each transfer. Fuel transfers would be controlled by a tanker operator on the barge who was trained in spill prevention and control. A second individual must be present on shore during all fuel transfers. If a leak occurred during transfer, the tanker operator would take immediate action to stop the leak by shutting down the transfer pump. The perimeter of each barge would be designed to contain spills, and spill containment also would be provided at the header, transfer points, and under the shore-side hook-up location.

Based on the operating experience of a major barge supplier of diesel fuel, the frequency of spills during transfer operations is about once every 500 transfers (Petro Marine, 1997). Under Alternative A, the Kensington Gold Project would require approximately 12 barge shipments of diesel fuel per year. The risk of a spill during transfer operations would be about 0.024 per year. When projected over the 14-year life of the project, the cumulative risk is about 0.336 (about 1 in 3) that a single spill would occur during transfer operations. The transfer pump has a rated capacity of 750 gallons per minute. If a leak or spill occurred during transfer, the tanker operator would be able to shut down the transfer pump within 1 minute. Prompt action by

the tanker operator would limit the spill to 750 gallons plus the volume of diesel fuel contained within the hose (about 130 gallons), resulting in a maximum spill of approximately 880 gallons. Engineered spill containment areas on the barge and shore-side would most likely prevent a major portion of such a spill from reaching the waters of Lynn Canal. Section 4.6 discusses the potential impacts of such a release to local aquatic life.

Material Onsite Transportation

Under Alternative A, the existing access road at the project site would be upgraded and relocated to support construction, mining, and ore-processing activities. The access road would extend approximately 2.2 miles from the marine terminal at Comet Beach to the 800-foot adit at the upper site.

Vehicle traffic on the access roads would comprise the following:

- Personnel movement to and from the heliport to the housing camp and other facilities
- Haulage of supplies, process chemicals, and explosives
- Fuel trucks
- Waste rock for construction and reclamation activities
- Road maintenance and equipment maintenance vehicles.

Vehicles using the access road would include semi-tractor/trailers, flatbed trucks, buses, carryalls, half- and three-quarter ton trucks, diesel tanker truck, fire truck, ambulance, fork lifts, grader, snowplow and explosives vehicle, and other vehicles as required to support mine and mill operations.

Under Alternative A, approximately 4,800 vehicle trips per year are estimated for the access road. The risks of accidents associated with transportation on the access road were estimated using statistical data supplied by the Alaska Department of Transportation and Public Facilities for rural highways in the State of Alaska (ADOTPF, 1995a; ADOTPF, 1995b). These data are expected to establish an upper bound on the potential risk of accident because average vehicle speeds are anticipated to be much lower on the access road than the average vehicle speeds on rural highways.

In addition to the risks of injury and fatality to personnel, the transportation of hazardous materials poses the risk of spills to the environment. Under Alternative A, as well as the other alternatives, the operator would be required to develop and implement a spill prevention, countermeasure, and control plan. Diesel fuel and sodium cyanide would pose the greatest risk to the environment if spilled. All fuel tanks and transfer points would be located in areas with secondary containment. A 5,000-gallon tanker truck would transport diesel fuel from storage tanks at the marine terminal to the process area. Approximately 180 diesel fuel shipments per year would be required to supply fuel for mining vehicles and equipment. The probability of an accident that would release the entire contents of a tanker truck is estimated to be about 0.00015 per year (about 1 in 7,000). Because the access road generally parallels Sherman Creek and would cross the creek or its tributaries in several places, any release of diesel fuel from a transportation accident could enter the waters of Sherman Creek. The maximum consequences

of a diesel fuel transportation accident would be the release of 5,000 gallons of diesel fuel to Sherman Creek with potential for migration into Lynn Canal. Prompt spill response actions would likely prevent a major portion of the release from reaching the waters of Sherman Creek or Lynn Canal, however. In addition, much of the road is at least several hundred feet from the creek. Under all alternatives, spill response equipment would be located at the marine terminal and process area and along the road midway between the two areas. Sections 4.6 and 4.7 discuss the potential impacts of this release to local aquatic life.

4.12.2 Effects Common to Alternatives B Through D

Material Offsite Transport

Materials, equipment, and fuel would be transported to the Kensington site by barge to a landing site at Comet Beach. During the operation phase, approximately 700 to 800 tons of freight and 540,000 gallons of diesel fuel would be shipped to the site monthly. In addition, the site would ship approximately 6,000 tons of processed ore each month for offsite gold recovery processing. This would require on average one freight barge and four to five processed ore barges per month (see the discussion in this subsection related to diesel fuel). The six additional barges per month associated with the Kensington Gold Project operations would equal a 2-percent increase in Lynn Canal traffic during the summer months and a 33-percent increase during the winter months. The larger percentage increase during winter months would have a minimal impact because the actual number of vessels would be small.

As with Alternative A, the project's barge traffic could affect commercial gillnet fishing in the vicinity of Point Sherman during the commercial fishing season. To minimize the potential impacts, the barges would be scheduled into the site on non-fishing days, and barges would be requested to approach the shoreline in a perpendicular fashion from the middle of Lynn Canal.

Under Alternatives B through D, approximately 6.5 million gallons of diesel would be used, which could increase diesel transport by about 3.25 percent or about two barges per year. Page 4-47 of the FEIS provides data on oil pollution events in Lynn Canal from 1986 through 1990. No events were associated with fuel barge sinkings or damage during this period or have occurred since then (U.S. Coast Guard, 1996). Therefore, the risk associated with barge transport of fuel to the Kensington Gold Project is minimal under Alternatives B through D.

Under Alternatives B through D, the increased number of diesel fuel barge shipments results in a higher risk of a diesel fuel spill during barge-to-shore fuel transfer operations compared to Alternative A. Under Alternatives B through D, the Kensington Gold Project would need about 52 barge transfers of diesel fuel per year. The risk of a spill during transfer operations would increase to about 0.104 per year. Projected over the 14-year life of the project, the cumulative risk would increase to about 1.5, indicating that 1 to 2 spills would be expected to occur during the life of the project. The maximum diesel fuel spill (about 880 gallons) and its consequences would be the same as those described under Alternative A.

Material Onsite Transport

Under Alternatives B through D, tailings slurry would be pumped to the backfill plant, and return water would be pumped back to the mill. Underground containment and check valves at the mine portal would limit the potential for any underground spills associated with a rupture to reach the surface. Therefore, the primary risk to water resources would be a spill in the 1,500-foot surface component of each pipeline. U.S. Department of Transportation (DOT) data on diesel pipeline failures were used to project the probability of a rupture. According to DOT, the annual probability of rupture is about 0.888 failures per thousand miles of pipeline. For each pipeline, this would result in an annual probability or rupture of about 0.03 in 100. The surface sections of the pipelines would be located in containment ditches to minimize any potential spill impacts.

4.12.3 Effects of Alternative B (Proposed Action)

Material Onsite Transport

Under Alternative B, approximately 37,000 vehicle trips per year are estimated for the onsite haul road, which is nearly an eight-fold increase over Alternative A. The large increase in shipments is due primarily to truck shipments of dewatered tailings from the upper site to the DTF. Truck shipments of processed ore and increased diesel fuel shipments also account for a portion of the increase.

The increase in shipments results in a higher probability for transportation accidents, injuries, and fatalities under Alternative B. The risk of vehicle accident is estimated to be 0.36 per year (i.e., a probability of about 1 in 3 that a single accident would occur). When projected over the 14-year life of the project, the cumulative risk is about five vehicle accidents during the life of the project. The risk of personnel injury as a result of a transportation accident is estimated to be 0.033 per year (about 1 in 30), with a cumulative risk of 0.47 (about 1 in 2) of a single transportation injury during the life of the project. The risk of personnel fatality as a result of a transportation accident is estimated to be 0.0047 per year (about 1 in 200), with a cumulative risk of 0.065 (about 1 in 15) for the life of the project.

In addition to the risks of injury and fatality to personnel, the transportation of hazardous materials poses the risk of spills to the environment. Under Alternative B, diesel fuel and lead nitrate would pose the greatest risk to the environment if spilled. Ore would not be processed onsite for gold recovery under Alternative B; therefore, sodium cyanide and other hazardous chemicals used for gold recovery processing and cyanide destruction would not transported or used onsite.

All fuel tanks and transfer points would be located in areas with secondary containment. A 5,000-gallon tanker truck would transport diesel fuel from storage tanks at the marine terminal to the upper site. Approximately 1,300 diesel fuel shipments per year would be required to supply fuel for power generation, mining vehicles, and equipment. The probability of an accident that would release the entire contents of the tanker truck is estimated to be about 0.0011

per year (about 1 in 900). The maximum consequences of a diesel fuel transportation accident would be the same as those described for Alternative A in Section 4.12.1.

Trucks would transport lead nitrate from the marine terminal to the upper site. Lead nitrate contained in 1-ton Flo-bins would be off-loaded from barges at the marine terminal. If it is assumed that five 1-ton Flo-bins would be transported per truck, about two truck shipments per year would be required to supply lead nitrate for ore processing. The probability of an accident that would release the entire contents of five Flo-bins is estimated to be about 8.1×10^{-7} per year (about 1 in a million). Because the haul road generally parallels Sherman Creek and would cross the creek or its tributaries in several places, any release of lead nitrate from a transportation accident could enter the waters of Sherman Creek. The maximum consequences of a lead nitrate transportation accident would be the release of 5 tons of lead nitrate to Sherman Creek with potential for migration into Lynn Canal. Sections 4.6 and 4.7 discuss the potential impacts of this release to local aquatic life.

In addition to hazardous materials, large quantities of dewatered tailings would be transported over the haul road. A transportation accident involving shipment of dewatered tailings was also evaluated. If it is assumed that 50 tons of dewatered tailings would be transported per truck, about 28,600 truck shipments per year would be required to transport tailings from the mine to the DTF. The probability of an accident that would release the entire contents of the truck is estimated to be about 0.012 per year (about 1 in 80). Because the haul road generally parallels Sherman Creek and would cross the creek or its tributaries in several places, any release of tailings from a transportation accident could enter the waters of Sherman Creek. The maximum consequences of a dewatered tailings transportation accident would be the release of 50 tons of tailings to Sherman Creek. Prompt spill response actions would likely prevent a major portion of the release from reaching the waters of Sherman Creek or Lynn Canal, however. In addition, much of the road is at least several hundred feet from the creek. Sections 4.6 and 4.7 discuss the potential impacts of this release to local aquatic life.

4.12.4 Effects of Alternative C (Marine Discharge)

Material Onsite Transport

Under Alternative C, approximately 36,000 vehicle trips per year are estimated for the onsite access road. This is about a seven-fold increase over Alternative A and is slightly less than Alternative B because of the elimination of diesel fuel shipments. Under Alternative C, a pipeline would transport diesel fuel from the marine terminal to the upper site.

The risk of vehicle accident is estimated to be 0.35 per year (i.e., a probability of about 1 in 3 that a single accident would occur). When projected over the 14-year life of the project, the cumulative risk is about five vehicle accidents during the life of the project. The risk of personnel injury as a result of a transportation accident is estimated to be 0.032 per year (about 1 in 30), with a cumulative risk of 0.45 (about 1 in 2) of a single transportation injury during the life of the project. The risk of personnel fatality as a result of a transportation accident is

estimated to be 0.0045 per year (about 1 in 200), with a cumulative risk of 0.063 (about 1 in 16) for the life of the project.

In addition to the risks of injury and fatality to personnel, the transportation of hazardous materials poses the risk of spills to the environment. Under Alternative C, diesel fuel and lead nitrate would pose the greatest risks to the environment if spilled.

Under Alternative C, diesel fuel would be transported by pipeline instead of truck. Based on data compiled by DOT, the average failure rate of petroleum pipelines resulting in oil spills in excess of 10,000 gallons is about 0.888 failures per thousand miles per year (Hovey and Farmer, 1993). For the 2.2-mile pipeline proposed under Alternative C, the annual probability of a large spill would be about 0.002 per year (1 in 500). The pipeline would be equipped with leak detection sensors, and pipeline fuel transfers would be stopped automatically upon detection of a leak. Any fuel contained in the pipeline upgradient from the leak would be available for spillage to the environment, however. The maximum spill would release the entire volume of the pipeline, about 17,000 gallons. Because the pipeline generally would parallel Sherman Creek, any release of diesel fuel from a pipeline spill could enter the waters of Sherman Creek. Therefore, the maximum consequences of a diesel fuel pipeline spill would be the release of 17,000 gallons of diesel fuel to Sherman Creek with potential for migration into Lynn Canal. Prompt spill response actions would prevent a major portion of the release from reaching surface waters, however. In addition, much of the pipeline would be located at least several hundred feet from the creek. The pipeline would be double-walled to minimize the potential impacts of any failure. Sections 4.6 and 4.7 discuss the potential impacts of a diesel fuel release to local aquatic life.

Under Alternative C, mine drainage and tailings effluent would also be piped to Lynn Canal for discharge. The probability of an effluent pipeline rupture and spill is assumed to be similar to the probability of diesel fuel pipeline failure (0.888 failures per thousand feet per year). Under Alternative C, this would represent 0.002 spills per year (1 in 500).

The probability and consequences of a transportation accident involving a shipment of lead nitrate would be the same as those described for Alternative B in Section 4.12.3.

In addition to hazardous materials, large quantities of dewatered tailings would be transported over the haul road under Alternative C. The probability and consequences of a transportation accident involving a shipment of dewatered tailings would be the same as those described for Alternative B.

4.12.5 Effects of Alternative D (Modified DTF Design)

Material Onsite Transport

Under Alternative D, approximately 8,400 vehicle trips per year are estimated for the onsite haul road. This is about a 75-percent increase over Alternative A and is considerably less than Alternatives B and C because of the elimination of truck shipments of dewatered tailings. Under Alternative D, tailings slurry would be transported by pipeline to the DTF.

The risk of vehicle accident is estimated to be 0.074 per year (i.e., or a probability of about 1 in 14 that a single accident would occur). When projected over the 14-year life of the project, the cumulative risk is about 1 vehicle accident during the life of the project. The risk of personnel injury as a result of a transportation accident is estimated to be 0.0069 per year (about 1 in 150), with a cumulative risk of 0.096 (about 1 in 10) of a single transportation injury during the life of the project. The risk of personnel fatality as a result of a transportation accident is estimated to be 0.00096 per year (about 1 in 1,000), with a cumulative risk of 0.014 (about 1 in 70) for the life of the project.

Under Alternative D, diesel fuel and lead nitrate pose the greatest risks to the environment if spilled as a result of a transportation accident. The probability and consequences of transportation accidents involving these materials would be the same as those described for Alternative B in Section 4.12.3.

An accidental spill associated with the tailings slurry pipeline was also evaluated. It is assumed that the average failure rate of the tailings slurry pipeline is the same as that determined for petroleum pipelines (i.e., 0.888 failures per thousand miles per year) (Hovey and Farmer, 1993). For the 8,500-foot (1.6-mile) pipeline proposed under Alternative D, the annual probability of a large spill would be about 0.0014 per year. The pipeline would be equipped with leak detection sensors, and pipeline transfers would be stopped automatically upon detection of a blockage or leak. Any slurry contained in the pipeline upgradient from the leak would be available for spillage to the environment, however. The maximum spill would release the entire volume of the pipeline, about 270,000 gallons. Because the pipeline generally would parallel Sherman Creek, it is assumed that any release of tailings slurry from a pipeline spill could enter the waters of Sherman Creek. Therefore, the maximum consequences of a tailings slurry pipeline spill would be the release of 270,000 gallons of slurry to Sherman Creek with potential for migration into Lynn Canal. Prompt spill response actions would prevent a major portion of the release from reaching surface waters, however. In addition, much of the pipeline would be located at least several hundred feet from the creek. Sections 4.6 and 4.7 discuss the potential impacts of this release to local aquatic life.

4.12.6 Cumulative Effects

Construction of the Jualin Project could lead to increased barge traffic in Lynn Canal associated with additional transportation of employees, fuel, supplies, and products. Specific effects cannot be determined until, if ever, development of a Jualin Project plan. The cumulative impacts on transportation (and all resources) from the Jualin Project would be addressed in a NEPA analysis of the Jualin Project. Goldbelt, Incorporated, has proposed development at Cascade Point. Initial development would consist of timber production and a lodge. Timber production and transport also could lead to additional barge traffic in Lynn Canal. In addition, development by Goldbelt eventually could include a fast ferry terminal, which would also affect marine traffic. Specific effects associated with a fast ferry can only be determined after completion of a development plan. NEPA analysis of the development proposal would include transportation impacts, including cumulative effects. As noted above, increased barge traffic from the Kensington Gold Project could easily be accommodated in Lynn Canal. If further

increases due to the potential projects described above would lead to excessive traffic within Lynn Canal, mitigation measures might need to be considered.

The Alaska DOT is preparing a Draft EIS for development of a road from Juneau to Skagway. The current proposed layout for the road passes immediately west of the proposed DTF. This could lead to potential transportation modifications to the Kensington Gold Project (i.e., employees and supplies could be brought to the site by vehicles). There would also be cumulative impacts on most resources considered in the Draft SEIS. Although an EIS is being prepared, the proposed plans for the road remain preliminary. Significant additional study, planning, and permitting would be required prior to project initiation. In addition, the construction phase probably would involve several years, possibly extending beyond the operation and reclamation of the Kensington Gold Project. Until a more detailed plan has been developed and moves forward towards implementation, analysis of specific effects would be premature.

4.12.7 Summary

Tables 4-31 and 4-32 summarize the frequency of annual truck shipments on the access or haul road and the annual barge shipments to the facility, respectively, for the alternatives. These tables outline the number of shipments required for waste rock, processed ore, tailings, fuel, and process chemicals, as well as the number of personnel shuttles that would be required.

Table 4-33 compares the annual and cumulative probabilities (i.e., the probability over the expected life of the project) of accidents, personal injuries, and fatalities that would be expected from trucking.

Under Alternatives B and D, the probability of a diesel fuel truck accident and spill is 0.0011 per year and 0.015 (1 in 67) over the project life. The maximum consequences of this spill would be 5,000 gallons of diesel fuel spilled into lower Sherman Creek. Under Alternative C, the probability of a pipeline accident and spill is 0.002 per year and 0.027 (1 in 37) over the project life. The maximum consequences of this spill would be 17,000 gallons of diesel fuel spilled into lower Sherman Creek, assuming the use of a 6-inch diameter pipeline.

Table 4-31. Summary of Truck Shipments by Alternative

	Annual Truck Shipments			
Materials	Alternative A	Alternative B	Alternative C	Alternative D
Waste Rock	3,000	3,000	3,000	3,000
Processed Ore	0	1,500	1,500	1,500
Dewatered Tailings	0	28,600	28,600	0
Diesel Fuel	180	1,300	0	1,300
Process Chemicals	1,000	1,500	1,500	1,500
Personnel Shuttles	600	1,100	1,100	1,100
Total	4,780	37,000	35,700	8,400

Table 4-32. Summary of Barge Shipments by Alternative

Materials	Annual Barge Shipments	
	Alternative A	Alternatives B, C, D
Diesel Fuel	12	52
LPG	12	0
Processed Ore	0	52
Freight	12	12
Total	36	116

Table 4-33. Truck Accident Rates by Alternative

Alternative	Annual Accident Probability	Cumulative Probability (project life)
A (No Action)	2.89e-02	4.05e-01
B (Proposed Action)	3.59e-01	5.03e+00
C (Marine Discharge)	3.46e-01	4.84e+00
D (Modified DTF Design)	7.41e-02	1.04e+00

Under Alternatives B and C, the probability of a tailings truck accident and spill is 0.012 per year and 0.168 (1 in 6) over the project life. The maximum consequences of this spill would be 50 tons of dewatered tailings spilled into lower Sherman Creek. Under Alternative D, the probability of a tailings pipeline accident and spill is 0.0014 per year and 0.02 (1 in 50) over the project life. The maximum consequences of this spill would be 270,000 gallons of tailings slurry spilled into lower Sherman Creek.

The construction of a diesel fuel pipeline under Alternative C would increase disturbance by 2 acres. The construction of the tailings and reclaim water pipelines under Alternative D would increase disturbance by approximately 3 acres. As discussed in Section 4.4, this could lead to increased sediment loadings to fresh water. However, these loadings would be minimized by adequate design and implementation of Forest Service and EPA BMPs. The construction of the tailings pipeline would not affect the specifications for the road due to the need to haul till and waste rock for DTF construction. Piping diesel fuel under Alternative C and tailings under Alternative D would slightly decrease transportation-related air emissions, as discussed in Section 4.1.

4.13 SUBSISTENCE

The potential effects of the project alternatives on subsistence resources and activities were analyzed in the FEIS on pages 4-113 and 4-114. This analysis indicates that there is not a significant possibility of a significant restriction to subsistence uses. This effect is common to all alternatives. This effect is also common to all alternatives in this SEIS.

4.14 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

An irreversible commitment of resources applies to the loss of non-renewable resources (e.g., minerals or cultural resources) and to resources that are only renewable over a long period of time (e.g., soil productivity). Irretrievable commitments apply to losses of renewable resources and to situations in which a resource can be irretrievably (temporarily) lost, but the action is not irreversible. Table 4-34 presents the irreversible and irretrievable commitment of resources for the Kensington Gold Project.

Table 4-34. Irreversible and Irretrievable Commitment of Resources

Resource	Alternative A	Alternative B	Alternative C	Alternative D
Air Quality	No foreseeable or predicted irreversible or irretrievable commitments. Project would comply with Alaska State implementation plan and ADEC air quality regulations.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Topography	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Geology	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Geotechnical Considerations	Irreversible and irretrievable commitments by mining approximately 20 million tons of ore and 1.2 million tons of waste rock. The precious metals would be committed to the market. The resultant tailings and waste rock have no use in the foreseeable future.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Surface Water Hydrology	Project would comply with stream restoration goals established by the Forest Service under the appropriate land use designation and by Alaska State agencies. No foreseeable or predicted irreversible or irretrievable impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Surface Water Quality	Project development would be required to comply with all applicable State and Federal water quality regulations. No foreseeable or predicted irreversible or irretrievable impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Ground Water Hydrology	Project development would be required to comply with all applicable State and Federal water quality regulations. No foreseeable or predicted irreversible or irretrievable impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.

Table 4-34. Irreversible and Irretrievable Commitment of Resources (continued)

Resource	Alternative A	Alternative B	Alternative C	Alternative D
Ground Water Quality	Project development would be required to comply with State and Federal water quality regulations. No forseeable or predicted irreversible or irretrievable impacts.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Aquatic Resources, Marine	Minor irretrievable losses of intertidal habitats and organisms associated with Comet Beach terminal.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Aquatic Resources, Fresh Water	Irretrievable loss of aquatic organisms in diverted portions of Sherman and Ophir creeks. Irreversible loss of Ophir and Sherman creek habitats that would not be reconstructed.	Irretrievable loss of aquatic organisms in diverted portions of Ophir Creek.	Same as Alternative B.	Same as Alternative B.
Soils, Vegetation, and Wetlands	Irreversible commitment of 86.5 acres of old growth forest and 51 acres of wetlands. Irretrievable commitment of 282 acres of soil productivity, including 220 acres of wetlands during operations.	Irreversible commitment of 72 acres of old growth forest and 147 acres of wetlands. Irretrievable commitment of 250 acres of soil productivity, including 96 acres of wetlands during operations.	Irreversible commitment of 73 acres of old growth forest and 147 acres of wetlands. Irretrievable commitment of 253 acres of soil productivity, including 99 acres of wetlands during operations.	Irreversible commitment of 73 acres of old growth forest and 165 acres of wetlands. Irretrievable commitment of 270 acres of soil productivity, including 98 acres of wetlands during operations.
Socioeconomic Resources	Irretrievable decrease in housing availability during project construction.	Same as Alternative A.	Same as Alternative A.	Same as Alternative A.
Wildlife	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Recreation	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Cultural Resources	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Visual Resources	Irretrievable and irreversible commitments would occur in the form of form, line, color, and texture contrast of a tailings structure constructed across Sherman Creek. Reclamation and natural succession of vegetation would be expected to eventually mitigate most long-term visual impacts.	Irretrievable and irreversible commitments of form, line, color, and texture contrast from DTF. Irretrievable commitments from borrow areas, roads, and structures. Reclamation and natural succession of vegetation would be expected to eventually mitigate most long-term visual impacts.	Same as Alternative B.	Same as Alternative B.
Subsistence	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Land Use	See FEIS.	See FEIS.	See FEIS.	See FEIS.
Noise	See FEIS.	See FEIS.	See FEIS.	See FEIS.

CHAPTER 5

LIST OF PREPARERS

5. LIST OF PREPARERS

The lead agency for preparation of this Draft Supplemental Environmental Impact Statement (SEIS) for the Kensington Gold Project was the U.S. Department of Agriculture, Forest Service, Tongass National Forest. Science Applications International Corporation (SAIC) assisted in the preparation of the Draft SEIS under a third-party agreement between the U.S. Environmental Protection Agency and Coeur Alaska, Incorporated, and has used several subcontractors during preparation of various sections. Table 5-1 lists the individuals by company or agency that contributed to this document, as well as their degrees, years of experience, and project role.

Table 5-1. Preparers, Experience, and Project Role

Preparer	Degrees/Years of Experience	Project Role
Science Applications International Corporation		
Ron Rimelman	B.S., Chemical Engineering Years of Experience: 10	SEIS Project Manager
Tom Enyeart	M.S., Environmental Engineering M.S., Nuclear Engineering B.S., Physics Years of Experience: 20	Transportation Specialist
Robert Henke	M.S., Wildlife Biology B.S., Fisheries and Wildlife Management Years of Experience: 14	Wildlife Biologist
John Gunn	M.S., Oceanography B.S., Physics Years of Experience: 25	Oceanographer
John Nuckles	B.S., Mechanical Engineering Years of Experience: 8	Air Quality Analyst
Charlie Phillips	M.A., Marine Biology B.A., Biology Years of Experience: 20	Marine Biologist
Tim Reeves	M.S. Range Watershed Hydrology B.S., Range Management Years of Experience: 13	Hydrologist
Gene Weglinski	M.S., Horticulture B.S., Botany Years of Experience: 8	Botanist
Margaret Siriano Weiler	B.A., Political Science Years of Experience: 10	Technical Editor
Klohn-Crippen		
Harvey McLeod	M.S., Soil Mechanics B.A.S.E., Applied Engineering Years of Experience: 25	Engineer

Table 5-1. Preparers, Experience, and Project Rule (continued)

Preparer	Degrees/Years of Experience	Project Role
MJM Research		
Larry Moulton	Ph.D., Fisheries Biology M.S., Fisheries Biology B.S., Fisheries Biology Years of Experience: 23	Fisheries Biologist
Consultant		
Reed Hansen	M.S., Public and International Affairs B.A., Political Science Years of Experience: 25	Economist
U.S. Department of Agriculture, Forest Service		
Roger Birk	B.S., Natural Resource Management Years of Experience: 19	SEIS Team Leader
Ronald Baer	B.S., Geology Years of Experience: 23	Geologist
Margaret Beilharz	B.S., Freshwater Ecosystems Years of Experience: 19	Hydrologist
Bruce Brunette	M.S., Civil Engineering B.S., Geology Years of Experience: 21	Geotechnical Engineer
Jennette deLeeuw	M.A., Geology B.S., Geology Years of Experience: 4	Minerals Management Specialist
Don Martin	B.S., Wildlife Management Years of Experience: 8	Biologist
Kathleen Morse	B.S., Natural Resource Economics Years of Experience: 10	Economist
Eric Ouderkirk	M.L.A., Landscape Architecture M.U.P., Urban Planning Years of Experience: 7	Analyst
Dennis Rogers	M.S., Geology B.S., Geology Years of Experience: 24	NEPA Coordinator
U.S. Army Corps of Engineers		
Victor O. Ross	B.S., Mining Engineering Years of Experience: 19	NEPA Coordinator
U.S. Environmental Protection Agency		
Rick Seaborne	M.P.A., Environmental Policy B.S., Environmental Science and Urban Planning Years of Experience: 20	NEPA Coordinator, Third-Party Contract Manager

CHAPTER 6

NOTICE OF INTENT TO PREPARE SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Intensive scoping for this proposed Forest Plan amendment was done in March and April of 1995. At that time it was thought that this amendment would be analyzed in documented as an environmental assessment. Given the scope of the proposal, and a desire to provide additional procedural opportunities for comment, the Forest Supervisor has decided to document this analysis in an environmental impact statement. By this notice, further scoping comments are invited from any who might not have commented before. Those who have, need not do so again. All input from the public will be considered in preparation of the draft environmental impact statement (DEIS).

The draft EIS (DEIS) is expected to be filed with the Environmental Protection Agency (EPA) and to be available for public review by November 1995. At that time EPA will publish a notice of availability of the DEIS in the Federal Register.

The comment period on the DEIS will be 45 days from the date that EPA's Notice of Availability appears in the Federal Register. It is very important that those interested in the management of the Sequoia National Forest participate at that time. To be the most helpful, comments on the DEIS should be as specific as possible and may address the adequacy of the statement or the merits of the alternatives discussed (see The Council on Environmental Quality Regulations for implementing the procedural provisions of the National Environmental Policy Act at 40 CFR 1503.3). Comments should refer to specific pages or chapters of the DEIS.

Federal court decisions have established that reviewers of DEIS's must structure their participation in the environmental review of the proposal so that it is meaningful and alerts an agency to the reviewers' position and contentions, *Vermont Yankee Nuclear Power Corp.* v. *NRDC,* 435 U.S. 519, 553 (1978). Also, environmental objections that could be raised at the DEIS stage, but that are not raised until after completion of the final EIS, may be waived or dismissed by the courts, *City of Angoon* v. *Hodel,* 803 F. 2d 1016, 1022 (9th Cir. 1986) and *Wisconsin Heritages, Inc.* v. *Harris,* 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Because of these court rulings, it is very important that those interested in this proposed action participate by the close of the comment period on the DEIS so that substantive comments and objections are made available to the Forest Service at a time when it can meaningfully consider them and respond to them in the final EIS.

After the comment period for the draft EIS ends, the comments received will be analyzed and considered by the Forest Service in the preparation of the Final EIS.

Dated: October 6, 1995.

Juliet B. Allen,

Acting Forest Supervisor.

[FR Doc. 95-25486 Filed 10-13-95; 8:45 am]

BILLING CODE 3410-11-M

Notice of Intent To Prepare a Supplemental Environmental Impact Statement To Disclose the Environmental Impacts of Proposed Changes to the Kensington Gold Mine Project; Tongass National Forest, Chatham Area, Juneau Ranger District, Juneau, AK

AGENCY: Forest Service, USDA.

ACTION: Notice, intent to prepare a supplemental environmental impact statement.

SUMMARY: Pursuant to section 102(2)(C) of the National Environmental Policy Act of 1969, the USDA Forest Service, Chatham Area, under the direction of the Juneau Ranger District, will prepare a supplemental environmental impact statement (SEIS) to analyze and display the effects of proposed changes to the Kensington Gold Project, located on public and private lands in southeastern Alaska. The proposed mine is operated by Coeur Alaska and is located approximately 45 miles north of downtown Juneau. The Record of Decision for the original Final Environmental Impact Statement was signed on January 29, 1992.

DATES: Comments will be accepted throughout the EIS process but, to be most useful during the analysis they should be received in writing by October 30, 1995.

ADDRESSES: Written comments and suggestions concerning the analysis should be sent to Roger Birk, Minerals Management Specialist, Juneau Ranger District, 8465 Old Dairy Road, Juneau, Alaska, 99801.

FOR FURTHER INFORMATION CONTACT: Roger Birk, Minerals Management Specialist, Juneau Ranger District, 8465 Old Dairy Road, Juneau, Alaska 99801; phone (907) 586-8800; fax (907) 586-8808.

SUPPLEMENTARY INFORMATION: The proposed operations are subject to approval of a Plan of Operations under 36 CFR, Part 228, which is intended to ensure that adverse environmental effects on National Forest System lands and resources are minimized. The proposed changes to the project's Plan of Operations include the following:

1. Advanced water treatment of the flotation tailings and dewatered CIL effluent with underground tailings disposal.
2. Avalanche control and management.
3. Discharge of treated tailings pond effluent to Sherman Creek with flow augmentation to meet end-of-pipe discharge standards.
4. New laydown area/helicopter pad relocation.
5. Use of diesel fuel for power generation rather than LPG (liquified petroleum gas).
6. Temporary construction camp.

The purpose and need for the proposed amendments to the Plan of Operations is to reduce potential impacts to commercial fisheries from a mixing zone in saltwater, reduce risks from avalanches, and increase the economic efficiency of the mine.

In addition to the Forest Service, the Environmental Protection Agency and U.S. Army Corps of Engineers have jurisdiction and will participate as cooperating agencies in the preparation of the SEIS. The Forest Service has agreed to be the lead agency. EPA will be responsible for assuring that the analysis provides sufficient information for issuance of a National Pollutant Discharge Elimination System permit under authority of the Clean Water Act. The Corps will be responsible for ensuring that the analysis provides sufficient information for issuance of a Section 404 of the Clean Water Act permit, Section 10 of the Rivers and Harbors Act of 1899 permit, and for compliance with Executive Order 11990 and 11900 for wetlands and floodplains. Memorandums of Understanding will be initiated with both of the cooperating agencies.

The decision to be made is whether or not to approve the Plan of Operations as amended or require the operator to revise its proposal. The original FEIS analyzed the effects of developing the Kensington Gold Project. The SEIS will analyze only the effects of the proposed changes to the Plan of Operations.

Key resources to be analyzed include water quality from the discharge to Sherman Creek; impacts to wetlands; impacts to fisheries from the discharge; visual and water quality effects and stability of disturbed areas such as the laydown area, new fuel tank sites, and avalanche control areas; air quality effects from diesel power generation; spill potential and effects of hauling and handling additional diesel fuel.

Gary A. Morrison, Forest Supervisor, Tongass National Forest, Chatham Area, is the responsible official.

The Forest Service is seeking information and comments from

Federal, State, and local agencies as well as individuals and organizations who may be interested in, or affected by the proposed action. Public scoping meetings are planned for Juneau at Centennial Hall from 2 p.m. until 7 p.m. on Wednesday, October 11 and in Haines at the Council Chambers in City Hall from 2 p.m. until 7 p.m. on Thursday, October 12. If weather precludes travel to Haines on the 12th, the meeting will be held October 19 instead.

The draft supplemental environmental impact statement should be available for public review by December 15, 1995. The comment period on the draft supplemental environmental impact statement will be 45 days from the date the Environmental Protection Agency publishes the notice of availability in the Federal Register.

The Forest Service believes, at this early stage, it is important to give reviewers notice of several court rulings related to public participation in the environmental review process. First, reviewers of draft environmental impact statements must structure their participation in the environmental review of the proposal so that it is meaningful and alerts an agency to the reviewer's position and contentions. *Vermont Yankee Nuclear Power Corp.* v. *NRDC, 435 U.S. 519, 553 (1978).* Also, environmental objections that could be raised at the draft environmental impact statement stage but that are not raised until after the completion of the final environmental impact statement may be waived or dismissed by the courts. *City of Angoon* v. *Hodel,* 803 F.2d. 1016, 1022 (9th Cir. 1986) and *Wisconsin Heritages, Inc.* v. *Harris,* 490 F. Supp. 1334, 1338 (E.D. Wis. 1980). Because of these court rulings, it is very important that those interested in this proposed action participate by the close of the 45 day comment period so that substantive comments and objections are made available to the Forest Service at a time when it can meaningfully consider them and respond to them in the final environmental impact statement. To assist the Forest Service in identifying and considering issues and concerns on the proposed action, comments on the draft environmental impact statement should be as specific as possible. It is also helpful if comments refer to specific pages or chapters of the draft statement. Comments may also address the adequacy of the draft environmental impact statement or the merits of the alternatives formulated and discussed in the statement. Reviewers may wish to refer to the Council on Environmental Quality Regulations for implementing the procedural provisions of the National Environmental Policy Act at 40 CFR 1503.3 in addressing these points.

The final supplemental environmental impact statement is scheduled to be completed by February 15, 1996. The Forest Supervisor for the Chatham Area of the Tongass National Forest will, as the responsible official for the EIS, make a decision regarding this proposal considering the comments, responses, and environmental consequences discussed in the Final SEIS, and applicable laws, regulations, and policies. The decision and supporting reasons will be documented in a Record of Decision.

Dated: September 29, 1995.

Gary A. Morrison,

Forest Supervisor.

[FR Doc. 95-25512 Filed 10-13-95; 8:45 am]

BILLING CODE 3410-11-M

DEPARTMENT OF COMMERCE

Foreign-Trade Zones Board

[Docket 60-95]

Foreign-Trade Zone 50, Long Beach, CA; Application for Expansion

An application has been submitted to the Foreign-Trade Zones Board (the Board) by the Board of Harbor Commissioners of the City of Long Beach, California, grantee of FTZ 50, requesting authority to expand its zone at a site in San Bernardino, California, within the Los Angeles-Long Beach Customs port of entry area. The application was submitted pursuant to the provisions of the Foreign-Trade Zones Act, as amended (19 U.S.C. 81a-81u), and the regulations of the Board (15 CFR part 400). It was formally filed on October 5, 1995.

FTZ 50 was approved on September 14, 1979 (Board Order 147, 44 F.R. 55919, 9/28/79) and expanded three times (Board Orders 298, 341 and 494). The zone project currently includes 3 general-purpose sites in the Los Angeles/Long Beach Customs port of entry area: *Site 1* (12 acres)—Parcel 1-A, 1500 West Dominguez St., Long Beach and Parcel 1-B, 727 Capital Drive, San Pedro; *Site 2* (1,855 acres)—California Commerce Center, Ontario; *Site 3* (92 acres)—including parcels within the Inter-City Commuter Station Redevelopment area in Santa Ana and, a warehouse facility at 3000 and 3100 Segerstrom Avenue and 2900 and 2930 South Fairview Street, within the South Harbor Redevelopment area, Santa Ana.

The applicant is now requesting authority to expand the zone to include an additional site (proposed *Site 4*—175 acres) within the 2,300-acre San Bernardino International Airport and Trade Center complex (formerly Norton Air Force Base) in San Bernardino, California. A 2.5 million square foot WorldPointe Center for International Trade is planned for the proposed zone site (located at the northwest corner of Mill Street and Tippecanoe Avenue). The developer of this project is the Inland Valley Development Agency. No specific manufacturing requests are being made at this time. Such requests would be made to the Board on a case-by-case basis.

In accordance with the Board's regulations (as revised, 56 FR 50790-50808, 10-8-91), a member of the FTZ Staff has been designated examiner to investigate the application and report to the Board.

Public comment on the application is invited from interested parties. Submissions (original and 3 copies) shall be addressed to the Board's Executive Secretary at the address below. The closing period for their receipt is December 15, 1995. Rebuttal comments in response to material submitted during the foregoing period may be submitted during the subsequent 15-day period to January 2, 1996.

A copy of the application and accompanying exhibits will be available for public inspection at each of the following locations:

U.S. Department of Commerce, District Office, 11000 Wilshire Boulevard, Room 9200, Los Angeles, California 90024

Office of the Executive Secretary, Foreign-Trade Zones Board, Room 3716, U.S. Department of Commerce, 14th and Pennsylvania Avenue, NW., Washington, DC 20230

Dated: October 6, 1995.

Dennis Puccinelli,

Acting Executive Secretary.

[FR Doc. 95-25606 Filed 10-13-95; 8:45 am]

BILLING CODE 3510-DS-P

[Docket 59-95]

Foreign-Trade Zone 8, Toledo, OH; Proposed Foreign-Trade Subzone BP Exploration & Oil Inc. (Oil Refineries); Lucas, Allen and Wood Counties, OH

An application has been submitted to the Foreign-Trade Zones Board (the Board) by the Toledo-Lucas County Port Authority, grantee of FTZ 8, requesting special-purpose subzone status for the oil refinery system of BP Exploration & Oil Inc., located at sites in Lucas/Allen/Wood Counties (Toledo and Lima areas), Ohio. The application was

CHAPTER 7

REFERENCES

7. REFERENCES

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CHAPTER 8

COORDINATION WITH OTHER GOVERNMENT AGENCIES, NON-GOVERNMENT ORGANIZATIONS, AND THE PUBLIC

8. COORDINATION WITH OTHER GOVERNMENT AGENCIES, NON-GOVERNMENT ORGANIZATIONS, AND THE PUBLIC

In scoping this Draft Supplemental Environmental Impact Statement (SEIS), the U.S. Department of Agriculture, Forest Service, Tongass National Forest, Chatham Area, actively solicited comments from a wide group of interested parties. The Forest Service published a Notice of Intent (NOI) in the *Federal Register* (60 *FR* 53583, October 16, 1995) announcing its intent to prepare an SEIS, as required under the National Environmental Policy Act. In addition, the NOI announced two scoping meetings to be held in August 1996 to accommodate requests from the public.

As a result of the scoping process, agency coordination activities, and information obtained during development of the Draft and Final EISs, the Forest Service developed its final coordination/mailing list of interested parties for distribution of the Draft SEIS. This list is presented on the following pages.

In addition to those receiving the SEIS through the initial direct mailing, anyone else desiring a copy of the this Draft SEIS, or wishing to comment on the document, should direct his or her correspondence to the address given on the cover sheet (page iii). All information received during the comment period will be considered during preparation of the Final SEIS.

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CHAPTER 9

ABBREVIATIONS AND ACRONYMS

9. ABBREVIATIONS AND ACRONYMS

ABA	Acid-base accounting
ac ft	Acre foot
ACMP	Alaska Coastal Management Program
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADNR	Alaska Department of Natural Resources
ADOTPF	Alaska Department of Transportation and Public Facilities
ADT	Average daily traffic
AEL&P	Alaska Electric Light & Power
A-J	Alaska-Juneau (A-J Mine Project)
ANFO	Ammonium nitrate fuel oil
BACT	Best available control technology
BLM	Bureau of Land Management
BMP	Best management practices
CBJ	City and Borough of Juneau
Cd	Cadmium
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	Cubic feet per second
CIL	Carbon-in-leach
Cl	Chlorine
cm	Centimeter
CO	Carbon Monoxide
Cr	Chromium
Cu	Copper
cu ft	Cubic feet
cu yd	Cubic yards
CWA	Clean Water Act
DEIS	Draft Environmental Impact Statement
DGC	Division of Governmental Coordination
DOT	U.S. Department of Transportation
DTF	Dry tailings facility
EIS	Environmental Impact Statement

EMT	Emergency medical technician
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FCC	Federal Communications Commission
FEIS	Final Environmental Impact Statement
gpm	Gallons per minute
HDPE	High density polyethylene
Hg	Mercury
kg	Kilogram
KV	Kilovolt
kW	Kilowatt
LPG	Liquefied petroleum gas
LUD	Land Use Designation
mbf	Thousand board feet
mg/kg	Milligrams per kilogram
mg/l	Milligrams per liter (equivalent to parts per million)
ML	Modified landscape
mmbf	Million board feet
MOU	Memorandum of Understanding
MSHA	U.S. Mine Safety and Health Administration
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
NaOH	Sodium hydroxide
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
Ni	Nickel
NMFS	National Marine Fisheries Service
NO_2	Nitrogen dioxide
NOAA	National Oceanographic and Atmospheric Administration
NO_X	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NP:MPA	Neutralization potential:maximum potential acidity
NPS	National Park Service
NSPS	New Source Performance Standards
NWS	National Weather Service

PAH	Polycyclic aromatic hydrocarbon
Pb	Lead
PM_{10}	Particulate matter
PMF	Probable maximum flood
PMP	Probable maximum precipitation
ppb	Parts per billion
ppm	Parts per million
ppt	Parts per thousand
PSD	Prevention of significant deterioration
QA/QC	Quality assurance/quality control
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
Se	Selenium
sec	Second
SCR	Selective catalytic reduction
SEIS	Supplemental Environmental Impact Statement
SHPO	State Historic Preservation Office
SIP	State implementation plan
SO_2	Sulfur dioxide
SO_X	Sulfur oxides
STD	Submarine tailings disposal
SWPPP	Storm Water Pollution Prevention Plan
TAR	Technical Assistance Report
TDS	Total dissolved solids
Te	Tellurium
TOC	Total organic carbon
tpd	Tons per day
tpy	Tons per year
TSP	Total suspended particulates
TSS	Total suspended solids
USDA	U.S. Department of Agriculture
USDOI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
USGS	United States Geological Survey
VOC	Volatile organic carbon

VQO	Visual quality objective
Zn	Zinc
μg/l	Micrograms per liter (equivalent to parts per billion)

CHAPTER 10

GLOSSARY

10. GLOSSARY

Acid-base accounting (ABA)	A test method to predict acid mine drainage. The "static" test compares a waste rock's maximum potential acidity with its maximum neutralization potential.
Acid-generating potential	The long-term potential of a material or waste to generate acid, as related to acid mine drainage.
Acid mine drainage	Drainage of water from areas that have been mined for mineral ores. The water has a low pH because of its contact with sulfur-bearing material. Dissolved metals, including heavy metals, may be present. Acid mine drainage may be harmful to aquatic organisms and to drinking water supplies.
Acre-foot	The amount of water which covers an acre of land to a depth of one foot; (ac ft) equal to 325,827 gallons.
Adit	A horizontal or nearly horizontal access tunnel into a mine from the surface.
Adsorb	To take up and hold by the physical or chemical forces of molecules.
Airshed	An area of land over which the pattern of air movement is influenced by major topographic features.
Alaska-Juneau (A-J) Project	Echo Bay Exploration, Incorporated, was conducting exploration work at the old Alaska-Juneau Mine located near downtown Juneau.
Alkaline	Having the qualities of a base; basic (pH greater than 7.0).
Alkaline chlorination	A treatment method by chemical reaction used to break down by chlorination the toxic cyanide radical (NC) into non-toxic sodium bicarbonate, nitrogen, sodium chloride, and water. This method may be used to treat mill effluent and tailings.
Alkalinity	The extent to which a solution is alkaline.
Alluvium	Material, including clay, silt, sand, gravel, and mud, deposited by flowing water.
Alternatives	For NEPA purposes, alternatives to the Proposed Action examined in an EIS. The discussion of alternatives must "sharply [define] the issues and [provide] a clear basis for choice...by the decision maker and the public" (40 CFR 1502.14).

Ameliorate	To influence or alter conditions so as to cause improvement.
Anadromous	Type of fish that migrate upstream from saltwater to freshwater to spawn (breed), such as salmon, some trout and char species, and shad. Also describes the fishery or habitat used for spawning by these species.
Ankerite	A mineral; a ferroan variety of dolomite (i.e., iron replaces the magnesium) $Ca(Fe, Mg, Mn)(CO_3)_2$.
Aquatic	Growing, living in, frequenting, or taking place in water. In this EIS, used to indicate habitat, vegetation, and wildlife in freshwater.
Aquifer	A zone, stratum, or group of strata acting as a hydraulic unit that stores or transmits water in sufficient quantities for beneficial use.
Aspect	The direction toward which a slope faces.
Attainment area	A geographic region within which National Ambient Air Quality Standards (NAAQS) are met; three categories of attainment are defined—Class I, Class II and Class III—on the basis of the level of degradation of air quality which may be permitted.
Ball mill	Equipment used to reduce ore particles to a finer size. It includes a large rotating cylinder partially filled with steel balls.
Barrel	A U.S. unit of measurement equal to 42 gallons of petroleum.
Base drain	A drain for water at the bottom of an impoundment or a storm runoff catchment.
Base flow	A sustained or fair-weather flow of a stream.
Baseline data	Data gathered prior to the proposed action to characterize pre-development site conditions.
Bathymetry	The measurement of depths of water in an ocean, lake or sea.
Benthic	All underwater bottom terrain from the shore line to the greatest deeps.
Berm	An earthen embankment, dike.
Best available control technology	Pollution control as defined by EPA for a specific emission or pollutant stream and required for meeting pollution control regulations.
Bioaccumulation	Pertaining to concentration of a compound, usually potentially toxic, in the tissues of an organism.

Bioassay	The study of living organisms to measure the effect of a substance, factor, or condition by comparing before-and-after exposure or other data.
Biodegradable	Capable of being broken down by the action of living organisms such as micro-organisms.
Biomass	The amount (weight or mass) of living material.
Biomonitoring	The use of living organisms to test the suitability of effluents for discharge into receiving waters and to test the quality of such waters downstream from the discharge.
Biota	All of the living material in a given area; often refers to vegetation.
Bond	An agreed to sum of money which, under contract, one party pays another party under conditions that when certain obligations or acts are met, the money is then returned; such as mining reclamation. See reclamation guarantee.
Borough	An area incorporated for the purpose of self government; a municipal corporation.
Borrow area	Earthen construction material source area such as sand and gravel, till, or top soil taken from specific area for use in construction and/or reclamation.
Breakwater	An offshore structure for breaking the forces of waves to protect a harbor or beach.
Cadmium	A tin-white, malleable, ductile, toxic, bivalent metallic element: used in electroplating of iron and steel and in the manufacture of bearing metals.
Calcite	A mineral, calcium carbonate ($CaCO_3$). One of the most common minerals; the principal constituent of limestone.
Canopy cover	The spreading branchy layer of forest vegetation.
Carbon-in-leach	A chemical process used to concentrate/beneficiate and recover gold from ore.
Carbon monoxide	A colorless, odorless very toxic gas that is formed as a product of incomplete combustion of carbon.
Catchment area	The drainage area or basin which is drained by a river, stream or system of streams.

Cathode	The negative terminal on an electrolytic cell; the electrode at which electrons enter a device from the external circuit.
Cubic feet per second (cfs)	1 cfs equals 448.33 gallons per minute.
Char	Closely related to trout, the char genus (*Salvelinus*) comprises Dolly Varden in the project area.
Chlorite	A term used for a group of hydrous sheet-like silicates of aluminum, iron, and magnesium.
Climax plant community	The stabilized plant community on a particular site. The relative composition of species does not change so long as the environment remains the same.
Closure	The final stage of mining that involves closure of all mine openings, regrading, and reclamation.
Colluvial	Soil material that has moved downhill and has accumulated on lower slopes and at the bottom of a hill consisting of alluvium in part and also containing angular fragments of the original rocks, i.e. cliff and avalanche debris.
Concentrate	The ore that contains the mineral sought following the concentration process (e.g., flotation, gravity).
Conductivity (electrical)	An electrical measurement to determine the amount of salinity or total dissolved solids in soils or surface and ground water.
Cone of depression	The geometry or shape of an inverted cone on the water table or artesian pressure surface caused by pumping of a well. The cone of depression will disappear over time when well pumping ceases.
Conifer	A broad classification of trees, mostly evergreens, that bear cones and have needle-shaped or scale-like leaves; timber commercially identified as softwood.
Copper	A red, ductile, malleable native metal found in hydrothermal deposits, cavities of basic igneous rocks and in zones of oxidization of copper veins.
Council on Environmental Quality	A body established by the National Environmental Protection Act (NEPA) to draft regulations for implementing and monitoring NEPA. The CEQ regulations are presented in 40 CFR 1500–1508.
Cover	Living or non-living material (e.g., vegetation) used by fish and wildlife for protection from predators and to ameliorate conditions of weather.

Criteria	Standards on which a judgment or decision can be based. Water quality criteria can be based on various standards, including aquatic life or human health.
Cumulative impacts	Combined impacts of the past, present and reasonably foreseeable future actions. For example, the impacts of a proposed timber sale and the development of a mine together result in cumulative impacts.
Cyanidation	A process of extracting precious metals such as gold by exposing prepared ore to a cyanide solution.
Cyanide solution	In commercial dissolution of gold from its ores, an alkaline aqueous solution of sodium or calcium cyanide.
Deciduous	Vegetation that sheds its leaves annually and replaces them following a period of dormancy.
Decommissioning	Suspension and/or closure of operations.
Deleterious	Hurtful, noxious, destructive.
Demography	A statistical study of the characteristics of human populations with reference to size, density, growth, distribution, migration and effect on social and economic conditions.
Depletion	Use of water in a manner that makes it no longer available to other users in the same system.
Deposit	A natural accumulation, such as precious metals, minerals, coal, gas, oil, dust, etc. that may be pursued for its intrinsic value; gold deposit.
Development	The work of driving openings to and into a proven ore body to prepare it for mining and transporting the ore.
Dewatering	The reduction of aquatic habitats by diversion of stream flow; removal of water from underground mine workings.
Diamond drilling	Rock drilling that makes use of a diamond tipped drill bit. Often used when recovering a core sample of rock.
Dilution	The act of mixing or thinning, and, therefore, decreasing a certain strength or concentration.
Diorite	A plutonic igneous rock composed of sodic plagioclase and hornblende, biotite, or pyroxene. Small amounts of quartz and orthoclase may be present.

Direct impacts	Impacts that are caused by the action and occur at the same time and place (40 CFR 1508.7). Synonymous with direct effects.
Discharge	The volume of water flowing past a point per unit time, commonly expressed as cubic feet per second, million gallons per day, gallons per minute, or cubic meters per second.
Dispersion	The act of distributing or separating into lower concentration or less dense units.
Diversion	Removing water from its natural course of location, or controlling water in its natural course of location, by means of a ditch, canal, flume, reservoir, bypass, pipeline, conduit, well, pump, or other structure or device.
Dry tailings facility (DTF)	A geotechnically engineered embankment used for the disposal of dewatered mine tailings.
Earthquake	Sudden movement of the earth resulting from faulting, volcanism, or other mechanisms within the earth.
Effluent discharge	Disposal of water previously used, as in a milling process.
Environmental Impact Statement (EIS)	Environmental impact statement - Means a detailed written statement as required by section 102(2)(C) of the National Environmental Policy Act (40 CFR 1508.11).
Endangered species	Any species which is in danger of extinction throughout all or a significant portion of its range.
Ephemeral stream	A stream channel that is normally dry; stream flow will occur for short periods of time in response to storm events.
Erosion	The wearing away of the land surface by running water, wind, ice or other agents.
Escapement	The number of adult anadromous fish (e.g., salmon) that escape fishing pressure and enter their natal streams to spawn.
Estuarine	Of, relating to, or formed in a place where an ocean tide meets the current of a fresh water stream.
Exacerbate	To cause some unfavorable condition to worsen.
Exploration	The search for economic deposits of minerals, ore, gas, oil or coal through the practices of geology, geochemistry, geophysics, drilling, shaft sinking and/or mapping.

404 Permit	Section 404 of the Clean Water Act specifies that anyone wishing to place dredged or fill materials into the waters of the United States and adjacent jurisdictional wetlands shall apply to the U.S. Army Corps of Engineers for approval. A permit issued by the Corps of Engineers for these activities is known as a 404 permit.
Fault	A displacement of rock along a shear surface.
Feasibility study	As applied to mining, the feasibility study follows discovery of the mineral and is prepared by the mining company or an independent consultant. Its purpose is to analyze the rate of monetary return that can be expected from the mine at a certain rate of production. Based on this study, the decision to develop the ore body may be made.
Filter cake	Resulting solids having a low moisture content following the extraction of water by filtering or a mechanical belt press.
Fines	Fine particulate matter; specifically particles less than 0.4 mm in diameter.
Fishery	All activities related to human harvest of a fisheries resource.
Flocculation	The addition of an agent to a settling pond that causes suspended particles to aggregate and settle out more rapidly than they would under natural conditions.
FLOOD	A computer model used to make independent estimates of storm rainfall and flood flows in ungauged (unmeasured) watersheds.
Flotation	An ore concentration process that separates ground ore from waste in a mixture of ore, water and chemicals. When air is forced through the ore/water mixture, the chemicals cause certain minerals to adhere to the air bubbles and float to the top in a froth, thus effecting a separation.
Flotation circuit	The portion of the milling process where the flotation process occurs. See flotation.
Flotation concentrate	The layer of mineral-laden foam built up at the surface up a flotation cell.
Forest Plan	Each of the National Forests administered by the USDA Forest Service is operated under a "Land and Resource Management Plan" as required by the National Forest Management Act of 1976. The 1976 Act was an amendment to the Multiple Use Sustained Yield Act of 1960 and the Forest and Rangeland Renewable Resources Planning Act of 1974. Forest Plans are prepared under the authority of these acts. For the Tongass National Forest, the existing Forest Plan is the Tongass Land Management Plan, as amended in 1986. This plan is currently being revised.

Friable	Easy to break, or crumbling naturally. Descriptive of certain rocks and minerals.
Fry	A recently hatched fish.
Fugitive dust	Dust particles suspended randomly in the air from road travel, excavation and rock loading operations.
Fugitive emissions	Emissions not caught by a capture system.
Furrow	A trench or ditch in the earth which may act as a watercourse for drainage or irrigation.
Geomorphic	Pertaining to the form of the surface of the earth.
Geotechnical	A branch of engineering that is essentially concerned with the engineering design aspects of slope stability, settlement, earth pressures, bearing capacity, seepage control, and erosion.
Gill net	A flat net suspended vertically in the water with meshes that allow the head of a fish to pass but entangle its gill covers upon withdrawal.
Glacial float	Rock moved by glacial activity.
Glaciofluvial	Of, relating to, or coming from streams deriving much or all of their water from the melting of a glacier.
Geotextile	A synthetic fabric used in the construction of earthen structures, such as embankments, landfills, roads, etc.
Grade	The content of precious metals per volume of rock (oz/ton).
Gradient	The inclination of the rate of regular or graded ascent or descent (as of a slope, roadway, or pipeline).
Gypsum	A naturally hydrated calcium sulfate, $CaSO_4 \bullet 2H_2O$, white or colorless, sometimes tinted grayish, reddish, yellowish, bluish, or brownish. Insoluble in water; soluble in ammonium salts, acids, and sodium chlorides.
Habitat	The natural environment of a plant or animal, including all biotic, climatic, and soil conditions, or other environmental influences affecting living conditions.
Hardness	Quality of water that prevents lathering because of the presence of calcium and magnesium salts which form insoluble soaps.

Hazardous waste	By-products of society than can pose a substantial or potential hazard to human health or the environment when improperly managed. Possesses at least one of four characteristics (ignitability, corrosivity, reactivity, or toxicity), or appears on special EPA lists.
Heavy metals	A group of elements, usually acquired by organisms in trace amounts, that are often toxic in higher concentrations; includes copper, lead, mercury, molybdenum, nickel, cobalt, chromium, iron, silver, etc.
Herbaceous	Vegetation that lacks woody tissue.
Heterogeneous	Not uniform in structure or composition.
Hydraulic barrier	An abrupt change in geology or soil type that inhibits the flow of water.
Hydraulic conductivity	A measure of the ability of soil to permit the flow of groundwater under a pressure gradient; permeability.
Hydrogen sulfide	A colorless, flammable, poisonous gas.
Hydrologic system	All physical factors, such as precipitation, stream flow, snowmelt, groundwater, etc., that affect the hydrology of a specific area.
Hydrophytic	Pertaining to aquatic plants requiring an abundance of water for growth.
Impermeable	Having a texture that does not permit the passage of fluids through its mass.
Impoundment	The accumulation of any form of water in a reservoir or other storage area.
In situ	A Latin term meaning "in place," in the natural or original position.
Incised	Cut into.
Increment	The amount of change from an existing concentration or amount; such as air pollutant concentrations.
Indigenous	Originating, developing, or produced naturally in a particular land, region, or environment; native.
Indirect impacts	Impacts that are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. (40 CFR 1508.8) Synonymous with indirect effects.
Infauna	Aquatic animals living in and on soft bottom substrates.
Infiltration	The movement of water or some other fluid into the soil through pores or other openings.

ISO container	A container that conforms to criteria established by the International Standards Organization for the transport of hazardous materials.
Infiltration gallery	A horizontal well or subsurface drain that intercepts the underflow in permeable materials or the infiltration of surface water.
Jurisdictional wetland	A wetland area delineated or identified by specific technical criteria, field indicators and other information for purposes of public agency jurisdiction. The public agencies which administer jurisdictional wetlands are the Fish and Wildlife Service, Army Corps of Engineers, Environmental Protection Agency and the USDA Natural Resource Service.
Land management plan	See forest plan.
Lime	Calcium oxide. Sometimes used as an abbreviated name for any rock consisting predominantly of calcium carbonate minerals.
Long-term impacts	Impacts that result in permanent changes to the environment. An example is a topographic change resulting from tailings disposal in a creek drainage.
Land Use Desiga-tion (LUD II)	LUD II compels the Forest Service to manage lands "in a roadless state to retain their wildland character, but permitting wildlife and fish habitat improvement and primitive recreational facility development." (Tongass Land Management Plan, amended 1986). Management implications for LUD II areas state that mineral development is subject to existing laws and regulations.
Marine discharge	Disposal of mine water, treated sewage, and/or storm water bypass.
Marine outfall	The mouth or outlet of a river, stream or pipeline where it enters the sea.
Median	The value of the middle number of a data set such that half of the data values are greater than the median and half of the data values are less than the median.
Microclimate	The local climate of a given area or habitat characterized by uniformity over the site.
Migratory	Moving from place to place, daily or seasonally.
Milling	The act or process of grinding, extraction, or mineral processing.
Mine drainage	Gravity flow of water from a mine to a point remote from mining operations.

Minimum streamflow requirement	A set amount of water to be maintained in a water course for the purpose of reasonably maintaining the environment.
Mining plan	See operating plan.
Mitigation measure	There are several meanings of mitigate: Avoid the impact by not taking action. Minimize the impact by limiting the degree of magnitude of the action and its implementation. Rectify the impact by repairing, rehabilitating, or restoring the affected environment. Reduce or eliminate the impact over time by preservation and maintenance operations during the life of the action. Compensate for the impact by replacing or providing substitute resources, or by enhancing the value of an adjacent existing environment.
Mixing zone	An area between an effluent discharge point and the associated water quality compliance monitoring station.
Monitoring	A continuing testing of specific environmental parameters and of project waste streams for purposes of comparing with permit stipulations, pollution control regulations, mitigation plan goals, etc.
Mines Safety and Health Administration (MSHA)	A Federal agency under the Department of Labor that regulates worker health and safety in mining operations.
Multiple use	The management concepts under which National Forest lands are managed. It involves the management of resources in combinations that will best serve the public.
National Register of Historic Places	A list, maintained by the National Park Service, of areas which have been designated as being of historical significance.
The National Environmental Policy Act of 1969 (NEPA)	National charter for protection of the environment. It establishes policy, sets goals, and provides means for carrying out the policy. 40 CFR 1500–1508 are the regulations for implementing the act.
NEPA process	All measures necessary to comply with the requirements of section 2 and Title I of NEPA.
New Source Performance Standards	Standards set by EPA defining the allowable pollutant discharge (air and water) and applicable pollution control for new facilities; by industrial category (Clean Air Act and Clean Water Act).

Nonpoint pollution	Pollution caused by sources that are non-stationary. In mining, nonpoint air pollution results from such activities as blasting and hauling minerals over roads, as well as dust from mineral stockpiles, tailings, and waste dumps prior to mulching and/or revegetation.
National Pollutant Discharge Elimination System (NPDES)	A program authorized by sections 318, 402 and 405 of the Clean Water Act, and implemented by regulations 40 CFR 122. NPDES program requires permits for the discharge of pollutants from any point source into waters of the United States.
100-year flood	A stream discharge that occurs on the average of once every 100 years.
Operating plan	Submitted by the mining operator, the operating plan outlines the steps the mining company will take to mine and reclaim the site. The operating plan is submitted prior to starting mining operations. Synonymous with the term mining plan (36 CFR, part 228).
Ore	Any deposit of rock from which a valuable mineral can be economically extracted.
Ore body	Generally, a solid and fairly continuous mass of ore, which may include low-grade ore and waste as well as pay ore, but is individualized by form or character from adjoining rock.
Ore reserve	Ore of which the grade and tonnage have been established with reasonable assurance by drilling and other means.
Organic Act	The 1897 act contains the basic authority for management of National Forests.
Organic matter	Matter composed of once-living organisms (carbon compounds).
Organism	A living individual of any plant or animal species.
Orographic effects	Pertaining to relief factors such as hills, mountains, plateaus, valleys, and slopes; usually used to describe weather patterns.
Outfall	A structure (i.e., pipeline) extending into a body of water for the purpose of discharging a waste stream, storm runoff, or water.
Oxide	A compound of oxygen with one or more elements or radicals.
Ozone	Form of oxygen (O_3) found largely in the stratosphere; a product of reaction between ultraviolet light and oxygen, or formed during combustion of hydrocarbon fuels.
Palustrine	Of, or relating to, shallow ponds, marshes, or swamps.

Palustrine forested A forested wetland dominated by woody vegetation over 20 feet tall.

Palustrine scrub-shrub A wetland area dominated by woody vegetation less than 20 feet tall.

Paste backfill The disposal of thickened mine tailings, after mixing with cement, in underground mines to provide wall or ground support.

Peak flow Highest flow; can be quantified as daily or instantaneous.

Permeability The capacity of a material for transmitting a fluid. Degree of permeability depends upon the size and shape of the pores, their interconnections, and the extent of the latter.

pH Symbol for the negative common logarithm of the hydrogen ion concentration (acidity) of a solution. The pH scale runs from 0 to 14, with a pH of 7 considered neutral. A pH number below 7 indicates acidity and a pH value above 7 indicates alkalinity or a base.

Phyllite A foliated metamorphic rock that is intermediate in composition and fabric between slate and schist.

Physiography A description of the features and phenomena of nature.

Piezometer A device for measuring moderate pressures of liquids.

Piezometric head The level to which a liquid rises in a piezometer, representing the static pressure of a water body.

Piezometric surface Any imaginary surface coinciding with the hydraulic pressure level of water in a confined aquifer, or the surface representing the static head of ground water and defined by the level to which water will rise in a well. A water table is a particular piezometric surface.

Plan of Operations See operating plan.

Plate filter A filter used to remove gold precipitate from solution.

Point source Stationary sources of potential pollutants. In terms of mining, some examples of point sources are crushing and screening equipment, conveyor and pond outlet pipes.

Pollution Human-caused or natural alteration of the physical, biological, and radiological integrity of water, air, or other aspects of the environment producing undesired effects.

Polychaete	Any of a class of mostly marine, annelid worms, having on most segments a pair of fleshy, leg-like appendages bearing numerous bristles.
Portal	The entrance to a tunnel or underground mine.
Potable water	Suitable, safe, or prepared for drinking.
Potentiometric surface	Surface to which water in an aquifer would rise by hydrostatic pressure.
Precious metal	Any of the less common and highly valuable metals; gold, silver, platinum.
Precipitation	The process of removing solid or liquid particles from a gas or smoke; the process of forming a precipitate from a solution (flocculation); rain, mist, snow, etc.
Prescriptive mitigation	The rules or directive in-place giving precise instructions on the abatement or alleviation of certain issues.
Prehistoric	Relating to the times just preceding the period of recorded history.
Prevention of Significant Deterioration (PSD)	Under provisions of the Federal Clean Air Act, a proposed new source of air pollution may be required to apply for PSD permit if certain emission limits are expected to be exceeded.
Process area	The area that encompasses the adit, mill, and processing facilities.
Process make-up water	Water required to make up for losses within the closed mill system.
Project area	The area within which all surface disturbance and development activity would occur.
Pristine	Pertaining to pure, original, uncontaminated conditions.
Probable maximum Flood (PMF)	A flood calculated to be the largest probable under any circumstances.
Probable maximum precipitation (PMP)	The theoretical physical maximum amount of precipitation which could occur at a given point or location.
Prospect	A property in which the mineral value has not been proven by exploration.
Public scoping	Scoping is an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action (40 CFR 1501.7).

Pycnocline A steep vertical gradient of density.

Pyrite A common mineral consisting of iron disulfide (FeS_2) with a pale brass-yellow color and brilliant metallic luster. It is burned to make sulfur dioxide and sulfuric acid.

Pyritic Relating to or resembling pyrite, a common mineral; iron disulfide.

Quartz A mineral, silicon dioxide (SiO_2) that, next to feldspar, is the most common mineral, and occurs in usually colorless, transparent crystals, but may be yellow, brown, purple, pink, or green.

Receiving waters A river, lake, ocean, stream, or other watercourse into which wastewater or treated effluent is discharged.

Reclamation Returning an area to resemble pre-mining conditions by regrading and reseeding areas disturbed during mining activity.

Reclamation guarantee A binding commitment payable to a governmental agency in the event that decommissioning and reclamation of an operation is not completed according to an approved plan. See bond.

Record of Decision (ROD) A document that discloses the decision on an environmental impact statement and the reasons why the decision was made; it is signed by the official responsible for implementing the identified action. The environmental consequences disclosed in an EIS are considered by the responsible official in reaching a decision (40 CFR, 1505.2).

Residence time The amount of time a receptor organism or object is in contact with a source.

Resident A species that is found in a particular habitat for a particular time period (i.e. winter resident, summer resident, year-round) as opposed to those found only when passing through on migration.

Resource Conservation and Recovery Act (RCRA) A 1976 act that is the primary law governing the regulation of solid and hazardous waste, as opposed to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA or Superfund) which provides the government with the authority and funds to clean up active or abandoned sites when there is a release or substantial threat of a release of hazardous substance from a facility.

Richter Scale A numerical (logarithmic) measure of earthquake magnitude.

Riparian	A type of ecological community that occurs adjacent to streams and rivers. It is characterized by certain types of vegetation, soils, hydrology and fauna and suited to conditions more moist than that normally found in the area.
Riprap	A layer of large rock placed together to prevent erosion of embankments, causeways, or other surfaces.
Riverine	Of, or relating to rivers, creeks, and streams.
Runoff	Precipitation that is not retained on the site where it falls, not absorbed by the soil; natural drainage away from an area.
Salinity	A measure of the dissolved salts in sea water.
Salmonids	Fish species (salmon, trout, and char) that belong to the same family; salmonidae.
Saturation	The extent or degree to which the voids in a material contain oil, gas, or water. Usually expressed in percent related to total void or pore space.
Section 10 Permit	Section 10 of the Rivers and Harbors Act of 1899 requires a permit for any structure or work that may obstruct traditionally navigable waters. This permit is issued by U.S. Army Corps of Engineers.
Sedentary organisms	Not migratory; staying in one place; stationary.
Sediment	Material suspended in liquid or air; also, the same material once it has been deposited.
Sediment basin	A pond, depression, or other device used to trap and hold sediment.
Sediment loading	The mass of solid erosion products deposited by or carried in water or air.
Sediment pond	Structures constructed by excavation and/or by building an embankment whose purpose is to retain water and allow for settlement of fines (TSS) and reduction in turbidity.
Seepage	The slow movement of gravitational water through the soil.
Selenium	A non-metallic, toxic element related to sulfur and tellurium; a byproduct of the electrolytic refining of copper.
Sensitive species	A plant or animal listed by a State or Federal agency as being of environmental concern; includes but is not limited to threatened and endangered species.

Sensitivity level	A measure of viewer interest in the scenic quality of the landscape.
Settling ponds	See sediment pond.
Short-term impacts	Impacts occurring during project construction and operation, and ceasing upon project closure and reclamation.
Significant issues	Of the issues raised during the scoping process for an environmental impact statement, certain of those issues are determined to be "significant" by the lead public agency. Determining which issues are significant, and thus meriting detailed study in the EIS, is the final step of the scoping process and varies with each project and each location. Significant issues are used to develop alternatives.
Slurry	A watery mixture or suspension of insoluble matter, such as mud or lime.
Sodium hydroxide	A common laboratory reagent; strongly alkaline when in solution with water.
Solid waste	Garbage, refuse, sludge from a waste treatment plant, water supply treatment plant, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities.
Spawn	To produce and/or deposit eggs or sperm; the eggs or sperm product (fish reproduction).
Spill Prevention Control and Countermeasure Plan (SPCC)	A plan that EPA requires of facilities storing more than a given threshold of fuel or hazardous material. It is a contingency plan for avoidance of, containment, of and response to hazardous materials spills or leaks.
Stockpiling	Storage of soils and/or rock material.
Stope	An excavation in a mine made for the purpose of extracting ore.
Stoping	A process by which ore is excavated in an underground mine; removal of ore from an underground excavation (stope).
Storm water	Overland flow generated as a result of a storm event.
Strata	A tabular mass or thin sheet of earth of one kind formed by natural causes usually in a series of layers of varying make-up; sedimentary units.
Stream channel geometry	The cross section of a stream channel (end view).

Stream gradient The rate of fall or loss of elevation over the physical length of a segment or total stream usually expressed in feet per feet (%).

Stream flow The discharge (flow of water) in a natural channel.

Study area The zone around the project area within which most potential direct and indirect effects to a specific resource would occur.

Subsidence A local lowering of land surface caused by the collapse of rock and soil into an underground void or by the removal of ground water; it can result in stability failures such as landslides and mine roof cave-ins.

Subsistence use Section 803 of the Alaska National Interest Lands Conservation Act defines subsistence use as: "The customary and traditional uses by rural Alaska residents of wild, renewable resources for direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of the non-edible by-products of fish and wildlife resources taken for personal or family consumption; for barter, or sharing for personal or family consumption; and for customary trade."

Substrate An underlayer of earth or rock.

Succession Changes in the plant communities composing an ecosystem as the ecosystem evolves from one type to another, e.g. wetlands becoming grassy meadows.

Sulfide A compound of sulfur with more than one element. Except for the sulfides of the alkali metals, the metallic sulfides are usually insoluble in water and occur in many cases as minerals.

Sump In the case of an underground mine, an excavation made underground to collect water, from which water is pumped to the surface or to another sump nearer the surface.

Surficial Characteristic of, relating to, formed on, situated at or occurring on the earth's surface; especially, consisting of unconsolidated residual, alluvial, or glacial deposits lying on the bedrock.

Synchronous Recurring or operating at exactly the same periods.

Tailings The non-economic constituents of the ground ore material that remains after the valuable minerals have been removed from raw materials.

Taxa (taxon) Any group of organisms, populations, or taxa considered to be sufficiently distinct from other such groups to be treated as a separate unit.

Terrestrial	Of or relating to the earth, soil, land; an inhabitant of the earth or land.
Thermistor	A resistor made of semiconductors having resistance that varies rapidly and predictably with temperature.
Threatened species	A plant or wildlife species officially designated by the U.S. Fish and Wildlife Service as having its existence threatened and is protected by the federal Threatened and Endangered Species Act.
Tideland	Land that is overflowed by the tide but exposed during times of low water.
Till	Non-sorted, non-stratified sediment carried or deposited by a glacier.
Timber slash	Non-economic timber refuse that is cut but remains in the area after timber harvest.
Topography	The physical configuration of a land surface.
Toxicity tests	Refers to predescribed laboratory analysis generally used to determine the degree of danger posed by a substance to animal or plant life.
Trace metals	Metals present in minor amount in the earth's crust (trace elements).
Transect	A sample area in the form of a long narrow continuous strip that is used for the tabulation of data.
Transmissivity (coefficient of)	A measure of the ability of an aquifer to transmit water.
Turbidity	Reduced water clarity resulting from the presence of suspended matter.
Unavoidable effects	Many effects which could occur from the project can be eliminated or minimized by management requirements and constraints and mitigation measures. Effects that cannot be eliminated are identified as unavoidable.
Understory	A foliage layer lying beneath and shaded by the main canopy of a forest.
Visual Management Objectives	Objectives identified by the Forest Service for management of viewsheds.
Vein	A mineralized zone having a more or less regular development in length, width, and depth. Commonly dipping at a steep angle to the horizontal.
Visual Quality Objective (VQO)	Used by the Forest Service in classifying visual resources of an area.

Visual resources	The visual quality of the landscape. The Forest Service manages viewsheds as a resource, establishing specific management objectives for different areas of Forest Service land.
Waste rock	Also known as development rock, waste rock is the non-ore rock that is extracted to gain access into the ore zone. It contains no gold or gold below the economic cutoff level.
Water balance	A measure of continuity of water flow in a fixed or open system.
Watershed	The entire land area that contributes water to a particular drainage system or stream.
Waters of the United States	All waters that are currently or could have been used in interstate or foreign commerce, including waters that are subject to the ebb and flow of the tide; wetlands; and lakes, rivers, streams, mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds.
Weathering	The process whereby larger particles of soils and rock are reduced to finer particles by wind, water, temperature changes, plant and bacteria action, and chemical reaction.
Wetlands	Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions.
Wilderness	Land designated by Congress as a component of the National Wilderness Preservation System.
Xanthates	A class of chemicals known as "collector" chemicals, which attach to normally non-floating minerals making them capable of adhering to the froth in a flotation circuit.

CHAPTER 11

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EVALUATION OF THE DISCHARGE

OF DREDGED AND FILL MATERIAL IN ACCORDANCE

WITH SECTION 404(b)(1) GUIDELINES (40 CFR 230)

US Army Corps of Engineers Alaska District

Applicant: Coeur Alaska, Incorporated
Application Number: 2-900592
Waterway Number: Lynn Canal 31

SUBPART A - GENERAL

Dredged or fill material should not be discharged into the aquatic ecosystem, unless it can be demonstrated that such a discharge will not have an unacceptable adverse impact either individually or in combination with known and/or probable impacts of other activities affecting the ecosystems of concern.

The Guidelines have been developed by the Administrator for the U.S. Environmental Protection Agency (EPA) in conjunction with the Secretary of the Army acting through the Chief of Engineers under Section 404(b)(1) of the Clean Water Act (33 U.S.C. 1344). The Guidelines are applicable to the specification of disposal sites for discharges of dredged or fill material into waters of the United States (U.S.).

In evaluating whether a particular discharge site may be specified, the following steps should generally be followed: (a) review the restriction on discharge, the measures to minimize adverse impact, and the required factual determinations; (b) examine practicable alternatives to the proposed discharge; (c) delineate the candidate disposal site; (d) evaluate the various physical and chemical components; (e) identify and evaluate any special or critical characteristics of the candidate disposal site and surrounding areas; (f) review Factual Determinations to determine whether the information is sufficient to provide the required documentation or to perform pre-testing evaluation; (g) evaluate the material to be discharged to determine the possibility of chemical contamination or physical incompatibility; (h) conduct the appropriate tests if there is a reasonable probability of chemical contamination; (i) identify appropriate and practicable changes in the project plan to minimize the impact; and (j) make and document Factual Determinations and Findings of Compliance.

SUBPART B - COMPLIANCE WITH THE GUIDELINES

The proposed Kensington Gold Mine, file number 2-900592, Lynn Canal 31, will involve discharges of fill material into special aquatic sites and other waters of the U.S. in order to develop the infrastructure to operate an underground gold mine. A description of the proposed project and alternatives considered is found in Chapter 2 of the Draft Supplemental Environmental Impact Statement (DSEIS). There are no practicable alternatives to the proposed discharge (applicant's preferred alternative) that would accomplish the project's purpose and need and not result in a discharge into special aquatic sites or have less adverse impact on the aquatic ecosystem. Therefore, the applicant's preferred alternative is the least damaging practicable alternative. A complete discussion of the alternatives considered is included Chapter 2 of the DSEIS; supporting descriptions of project

components are also presented in Chapter 2 of the Kensington Mine Project Final Environmental Impact Statement (FEIS).

As determined in Subparts C through G of this evaluation and as discussed in Chapter 4 of the DSEIS, the proposed project will not contribute to significant degradation of the waters of the U.S. including adverse effects on human health or welfare, life stages of aquatic life and other wildlife dependent on aquatic ecosystems, aquatic ecosystem diversity, productivity and stability, and recreational, aesthetic, and economic values. The project includes the reclamation of the site to standards and goals that are acceptable to the Federal land managing agency, the USFS. In addition, the discharge of fill materials associated with the applicants' preferred alternative complies with the requirements of the Guidelines.

SUBPART C - POTENTIAL IMPACTS ON PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

Applicable information about direct, indirect and cumulative environmental impacts of the proposed project and alternatives related to substrate, suspended particulates/turbidity, water, current patterns and water circulation, and normal water fluctuations is contained in Chapter 4 of the DSEIS and FEIS. Adverse impacts to these characteristics are expected to be relatively minor or negligible.

SUBPART D - POTENTIAL IMPACTS ON BIOLOGICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

Pertinent information about direct, indirect and cumulative impacts of the proposed project and alternatives related to threatened and endangered species, fish, aquatic organisms, and other wildlife is contained in Chapter 4 of the DSEIS. Adverse impacts resulting from the discharge of dredged and/or fill materials are expected to result in the permanent loss of approximately 147 acres of aquatic habitat. Palustrine wetlands would be lost through the construction of the dry tailings facility (DTF) and the processing facility. The DSEIS and FEIS discuss the potential for direct and indirect adverse effects on fish and wildlife habitat. Indirect impacts resulting from the proposed project are expected to occur only on a localized basis within the Sherman Creek basin and in the Terrace Area and would be minor.

SUBPART E - POTENTIAL IMPACTS ON SPECIAL AQUATIC SITES

The proposed project is expected to affect 243 acres of special aquatic sites during the life of the project. Of these impacts, 147 acres of special aquatic sites are expected to be impacted permanently. While special aquatic sites would be impacted, final reclamation would ultimately increase in diversity of habitats occurring at the site. Open water habitat, not currently present at the site would be created (55 acres) and new upland habitat would be provided from the reclaimed DTF. Discussions about impacts on functions and values associated with wetlands are found in Chapter 4 of the DSEIS and FEIS.

SUBPART F - POTENTIAL EFFECTS ON HUMAN USE CHARACTERISTICS

Human use characteristics that will be affected by the proposed project include water supplies, fisheries, water-related recreation, aesthetics, and recreation areas. Pertinent information about potential impacts of the proposed work on human use characteristics is found in Chapter 4 of the DSEIS

and FEIS. Anticipated impacts, both beneficial and detrimental, range from relatively minor to major depending on the characteristic. The major impact of the mine would result from the infusion of payroll and taxes to the area.

SUBPART G - EVALUATION AND TESTING

The potential for encountering hazardous wastes is discussed in Chapter 2 of the DSEIS. Based on these discussions, the likelihood of materials to be discharged containing contaminants is remote. Therefore, the discharged material meet the testing exclusion criteria.

SUBPART H - ACTIONS TO MINIMIZE ADVERSE EFFECTS

Actions proposed to minimize potential adverse effects for each alternative considered are discussed in Chapters 2 and 4 of the DSEIS.

In accordance with 33 U.S.C. 1341(d), all conditions on the Alaska Department of Environmental Conservation certification, if any, will be incorporated as part of the DA permit.

US Army Corps
of Engineers

Alaska District

Regulatory Branch (1145b)
Post Office Box 898
Anchorage, Alaska 99506-0898

Public Notice of Application for Permit

PUBLIC NOTICE DATE: The comment period for this notice is concurrent with the Draft Supplemental Environmental Impact Statement comment period.

EXPIRATION DATE:

REFERENCE NUMBER: 2-900592

WATERWAY NUMBER: Lynn Canal 31

Interested parties are hereby notified that a Draft application has been received for a Department of the Army, Corps of Engineers (Corps) permit for certain work in waters of the United States, as described below and shown on the attached plan. It is anticipated there may be changes to the proposal as it undergoes this concurrent NEPA review. Please see additional information below.

APPLICANT: Coeur Alaska, Incorporated, 431 N. Franklin St., Suite 400, Juneau, Alaska 99801.

LOCATION: The project is located in Sections 31 and 32, T., 34 S., R. 62 E., and Sections 5 and 6, T., 35 S., R. 62 E., Copper River Meridian. The project is located adjacent to Lynn Canal including land in the Sherman Creek, and Ophir Creek drainages, and on a remnant beach terrace South of Sherman Creek.

WORK: In order to develop the infrastructure to operate an underground gold mine, the applicant proposes to excavate and place fill into approximately 245 acres of jurisdictional wetlands and/or other waters of the United States. The total surface disturbance for the project is approximately 253 acres. The project would involve the excavation of approximately 3,236,500 cubic yards of material from jurisdictional wetlands and/or other waters of the United States. There would be a total of 4,172,020 cubic yards of fill material deposited in jurisdictional wetlands and/or waters of the United States. There would be approximately 15,150,000 cubic yards of tailings permanently stored on site. The major surface components proposed for the Kensington underground gold mine are listed below. Please consult the attached

plans and tables for additional details. The figures below have been rounded to the nearest whole number.

1. Mechanized land clearing, followed by the excavation of wetlands, and the placement of fill to construct the base, containment and drain structures for the Dry Tailings Storage Facility (DTF). The DTF is a permanent disposal and storage site for mill tailings. This component would have a footprint of approximately 113 acres in wetlands.

2. Mechanized land clearing, followed by the excavation of wetlands, to expose the underlying gravels. The sand and gravel would be removed and used as construction material in roads, building and facility pads, berms, drains, and ponds. These components would have a footprint of approximately 43 acres in wetlands.

3. Mechanized land clearing, followed by the excavation of wetlands, and the placement of fill for building pads for the ore process area, batch plant and personnel camp. These components would have a footprint of approximately 42 acres in wetlands.

4. Ophir Creek would be rerouted to avoid conflicts with the proposed gravel extraction site. A series of arched (conduit) culverts would be placed into Sherman Creek to allow construction of the haul road and provide a protective stream structure at the base of the process area bench slope. Excavation activities for the process area would be graded during construction. The resultant toe of the slope would encroach on Sherman Creek. The use of the conduit culverts would provide protection of the existing stream channel, and eliminates rerouting this portion of the stream. The upper Sherman Creek conduit would be 380 feet in total length. A series of a conduit culverts would be placed on Ivanhoe Creek for a haul road to the gravel extraction site. These component footprints are included within the disturbance for the process facility and the gravel extraction sites.

5. Mechanized land clearing, followed by the excavation of wetlands, and the placement of fill to construct dissemination areas, mine water sedimentation ponds, storm water and sediment detention ponds, a sedimentation facility, a topsoil stockpile area, laydown area, and an explosives magazine. These components would have a footprint of approximately 22 acres in wetlands.

6. Mechanized land clearing, followed by the excavation of wetlands, and the placement of fill to construct roads between all the surface facilities and the underground operation. This component would have a footprint of approximately 22 acres in wetlands.

7. Construct a marine barge facility on Lynn Canal. This would involve the excavation of the beach and the placement of concrete planks for a landing ramp. There would be four mooring buoys placed in Lynn Canal for tugs and barges. Fuel would be transferred from barges to the lower fuel tank using a floating pipeline which would be stowed after each use. This component would have a footprint of approximately 2 acres within waters of the United States.

8. All surface disturbance would be reclaimed according to the specifications in the reclamation plan. The reclamation plan stresses concurrent reclamation. Reclamation would include, but is not limited to, the following: Remove all structures, regrade all disturbance, apply topsoil to regraded areas, replant disturbed areas, seal all openings to the ore body, reestablish drainage ways, contour the DTF, cap the DTF, resoil and reseed the DTF. The stream diversions would be

regraded at the end of the operation and Sherman and Ophir Creeks returned to their original channels. The reclamation plan addresses the total and complete project. The reclamation plan dated January 16, 1997, is an integral part of the applicant's proposal.

9. The lower fuel tank and containment berm, heliport, helicopter hanger, wastewater treatment facility, and concentrate storage area, are all located in uplands outside of the Corps' jurisdiction. These components are adjacent to the marine barge facility. The upper portal is also located outside of the Corps jurisdiction. These components have a footprint of approximately 8 acres.

PURPOSE: The purpose of the proposed work is to develop the infrastructure to construct, operate, and ultimately reclaim the Kensington Mine. The Kensington Gold Mine is proposed as an underground mine with surface facilities to recover a gold concentrate.

ADDITIONAL INFORMATION: This public notice is being released concurrently with the release of the Draft Supplemental Environmental Impact Statement (DSEIS) for the Kensington Gold Mine. The Supplemental Environmental Impact Statement (SEIS) is being prepared by the United States Forest Service (USFS), Juneau Ranger District. The Corps and the Environmental Protection Agency (EPA) are cooperating agencies in the Kensington Gold Mine SEIS. This is a public notice of a draft permit application for the Kensington Gold Mine. A second public notice will be released concurrently with the Final Supplemental Environmental Impact Statement (FSEIS) for the project. The public notice released with the FSEIS will detail any proposed changes in the project as a result of this public comment and review. The public notice with the FSEIS will include the final Corps permit application and final proposed plans. A SEIS is being prepared as substantial changes have been proposed in portions of the Plan of Operation since the Kensington Final EIS (FEIS) Record of Decision was signed by the USFS on January 29, 1992. The FEIS issued in February 1992 includes relevant discussion and analysis. The relevant issues and analysis have been carried forward to this SEIS.

The Corps does not regulate the disposal of mine tailings. The DTF is a disposal and containment site, much like a sanitary landfill in function. The tailings disposal would be regulated by the State of Alaska, Department of Environmental Conservation, through their solid waste permit. The USFS would also regulate the design and operation of the facility through their Plan of Operation. The Corps would regulate the excavation of the wetlands, and the discharge of fill materials, such as glacial till, placed into the identified wetlands.

The current project is solely owned and operated by Coeur Alaska, Incorporated. There is no joint venture partner in the project. Coeur Alaska, Incorporated in response to earlier public and agency concerns, has chosen to redesign the project from that originally analyzed in the FEIS. The new plans are substantially different from those reviewed and commented upon at the previous Corps public hearings. The Kensington Gold Mine Technical Assistance Report (TAR) was published by EPA in October 1994. The Corps sponsored public hearings to solicit public comments with the release of this new information and analysis. The Corps public hearings were held December 13, 1994, in Juneau, Alaska and on December 14, 1994, in Haines, Alaska. With these public hearings the Corps released public notices that showed the proposed modified plans. The original plans and modified plans are now replaced by the plans found in this public notice and dated January 1997. The Corps did not

complete a permit decision after the public hearings. The proposed changes include:

ELIMINATION of the impoundment in Sherman Creek;
ELIMINATION of cyanide from the mill circuit;
ELIMINATION of the impoundment structure and all associated facilities;
ELIMINATION of the impoundment effluent outfall to Lynn Canal;
ELIMINATION of on-site gold recovery and refining;
A CHANGE to off-site gold recovery and refining;
A CHANGE from LPG to diesel fuel for power generation;
A CHANGE in the location of the personnel camp;
A CHANGE in the location of the mine water outfall;
A CHANGE in the layout of the upper facilities;
THE ADDITION of a dry tailings storage facility on-site, the DTF;
THE ADDITION of material pits in upper Sherman Creek.

The new project has resulted in a net reduction in total surface disturbance (footprint) of approximately 27 acres. (From 280 acres to 253 acres.) All the water quality analysis for the proposed project is found in the DSEIS for the Kensington Gold Mine. There will not be a separate Technical Assistance Report on water quality prepared by EPA and submitted to the Corps. Additional copies of the DSEIS may be obtained from Mr. Roger Birk, EIS Team Leader, Region 10, Tongass National Forest, Juneau Ranger District, 8465 Old Dairy Road, Juneau, Alaska 99801 or by phone at (907) 586-8800. A copy of the Kensington Plan of Operation can be reviewed at the Corps Regulatory Branch in Anchorage, at the USFS Office in Juneau or at Coeur Alaska's Office in Juneau. Further information and details on this project may be obtained from Mr. Eric Klepfer, Coeur Alaska Incorporated, 431 N. Franklin St., Suite 400, Juneau, Alaska 99801 or by phone at (907) 463-5425.

The Corps authorization is not the only authorization required for the operation of the Mine. The USFS must complete a Record of Decision for the Plan of Operation. The EPA must issue a National Pollution Discharge Elimination System (NPDES) Permit for the proposed project. The City and Borough of Juneau (CBJ) must complete their large mine permit review. In addition, there are additional permits and authorizations that must be completed by the following agencies: The State of Alaska, Department of Natural Resources, Department of Environmental Conservation, Department of Fish and Game; Division of Mining; and the Division of Governmental Coordination; the Federal Bureau of Alcohol Tobacco and Firearms; the Federal Communications Commission; and the United States Coast Guard.

MITIGATION: As a result of project planning, the applicant has incorporated into the proposed project the following activities to reduce impacts to the aquatic environment: The applicant has completed a comprehensive reclamation plan for the project that addresses final abandonment for each project component. The reclamation plan sets post mining goals for each surface disturbing activity within the project area. The applicant proposes that the material sites, mine water ponds, sedimentation ponds, and storm water ponds be left as waters of the United States in the form of ponds. These ponds would be designed and graded to encourage fringe wetland habitats. There would be approximately 55 acres of open water habitat left at the conclusion of the project. The process area pads, personnel camp pad, and batch plant pad, would all be regraded, topsoil applied, and the area seeded to encourage and maximize the opportunities for the land to return to wetlands. There would be a total of 42 acres reclaimed in this manner. Ophir Creek and Sherman Creek would be returned to their original

channels at the conclusion of the project. The series conduit culverts would be removed. The DTF would not return to a wetland, but the DTF would be concurrently regraded, capped, and seeded to prevent erosion while native species invade the upland DTF. The roads on site would be regraded, topsoil applied, and seeded to minimize erosion. All 22 acres of the road system would be reclaimed. The marine facility would be recontoured, all buildings removed, and the beach regraded to the predisturbance contour. The attached plans show reclamation objectives, typical reclaimed cross-sections, and final project contours.

WATER QUALITY CERTIFICATION: A permit for the described work will not be issued until a certification or waiver of certification as required under Section 401 of the Clean Water Act (Public Law 95-217), has been received from the Alaska Department of Environmental Conservation (ADEC).

COASTAL ZONE MANAGEMENT ACT CERTIFICATION: Section 307(c)(3) of the Coastal Zone Management Act of 1972, as amended by 16 U.S.C. 1456(c)(3), requires the applicant to certify that the described activity affecting land or water uses in the Coastal Zone complies with the Alaska Coastal Management Program. A permit will not be issued until the Office of Management and Budget, Division of Governmental Coordination has concurred with the applicant's certification.

PUBLIC HEARING: Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing.

CULTURAL RESOURCES: The USFS has assumed responsibility for completion of review under Section 106 of the National Historic Preservation Act. A Programmatic Agreement (PA) has been signed by the Forest Service, State Historic Preservation Officer (SHPO), and other interested parties. The PA has been ratified by the Advisory Council on Historic Preservation.

ENDANGERED SPECIES: The project area is within the known or historic range of the Hump back whale, American and Peale's Peregrine Falcon. Preliminary, the described activity will not affect threatened or endangered species, or their critical habitat designated as endangered or threatened, under the Endangered Species Act of 1973 (87 Stat. 844). This application is being coordinated with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. Any comments they may have concerning endangered or threatened wildlife or plants or their critical habitat will be considered in our final assessment of the described work.

FEDERAL SPECIES OF CONCERN: The following Federal species of concern may use the project area: Steelhead Trout, Sockeye Salmon, Chinook Salmon, Coho Salmon, Canada Goose, White-fronted Goose, Tule White-fronted Goose, Bald Eagle, Trumpeter Swan, Mallard, Black Brant, Tundra Swan, American and Peale's Peregrine Falcon.

FLOOD PLAIN MANAGEMENT: Evaluation of the described activity will include conformance with appropriate State or local flood plain standards; consideration of alternative sites and methods of accomplishment; and weighing of the positive, concentrated and dispersed, and short and long-term impacts on the flood plain.

SPECIAL AREA DESIGNATION: The project is located within the Tongass National Forest, and within the City and Borough of Juneau.

EVALUATION: The decision whether to issue a permit will be based on an evaluation of the probable impacts including cumulative impacts of the proposed activity and its intended use on the public interest. Evaluation of the probable impacts which the proposed activity may have on the public interest requires a careful weighing of all those factors which become relevant in each particular case. The benefits which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. The decision whether to authorize a proposal, and if so, the conditions under which it will be allowed to occur, are therefore determined by the outcome of the general balancing process. That decision should reflect the national concern for both protection and utilization of important resources. All factors which may be relevant to the proposal must be considered including the cumulative effects thereof. Among those are conservation, economics, aesthetics, general environmental concerns, wetlands, cultural values, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and, in general, the needs and welfare of the people. For activities involving 404 discharges, a permit will be denied if the discharge that would be authorized by such permit would not comply with the Environmental Protection Agency's 404(b)(1) guidelines. Subject to the preceding sentence and any other applicable guidelines or criteria (see Sections 320.2 and 320.3), a permit will be granted unless the District Engineer determines that it would be contrary to the public interest.

The Corps of Engineers is soliciting comments from the public; Federal, State, and local agencies and officials; Native Corporations, Indian Tribes; and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps of Engineers to determine whether to issue, modify, condition or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. Comments will be used in the preparation of an Environmental Impact Statement pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

All comments submitted to the Alaskan District, United States, Army Corps of Engineers should cite the reference number for this project, 2-900592, Lynn Canal 31. Comments on the adequacy of the DSEIS for the described work under the Corps jurisdiction should reach this office no latter than 45 days after the public notice of availability of the DSEIS in the Federal Register. Public comments will be solicited and accepted a second time after publication of the FSEIS. Final comments on the described work, with the reference number, should reach this office no later than 30 days after the public notice of availability for the FSEIS in order to become part of the record, and be considered in the permit decision. Copies of comments submitted to the Corps should also be sent to Mr. Roger Birk, EIS Team Leader, Region 10, Tongass National Forest, Juneau Ranger District, 8465 Old Dairy Road, Juneau, Alaska 99801. Please contact Mr. Victor O. Ross at (907) 753-2724 if further information is desired concerning this public notice.

AUTHORITY: This permit will be issued or denied under the following authorities:

(X) Perform work in or affecting navigable waters of the United States - Section 10 Rivers and Harbors Act 1899 (33 U.S.C. 403).

(X) Discharge dredged or fill material into waters of the United States - Section 404 Clean Water Act (33 U.S.C. 1344). Therefore, our public interest review will consider the guidelines set forth under Section 404(b) of the Clean Water Act (40 CFR 230).

A table of cut and fill volumes, an index to the plans, and the forty sheets of plans are attached to this public notice.

District Engineer
U.S. Army, Corps of Engineers

Attachments

Attachment·3

TABLE 2.1

ESTIMATED DISTURBANCE AREA AND VOLUME QUANTITIES

Parcel	Facility	Area Acres	Volume Cut (cy)	Volume Fill (cy)	Reclaimed Objective
1	Marine Terminal	2.3	80,000	5,300	UL/WL
1a	Jurisdictional Tidelands (2.1)		75, 000	500	ML
2	Explosives Magazine	2.9	30,000	31,400	WL
3	Access Road	21.6	50,000	75,800	WL
4	Dry Tailings Facility(1)	113.4	214,000	17,905,800	UL/OW
5	Stormwater Detention and Sediment Pond	4.2	12,000	17,880	OW/WL
6	Fuel Storage	0.3	1,200	1,200	WL
7	Laydown Area	0.8	1,300	1,300	WL
8	Borrow Site	26.8	1,660,000	0	OW/WL
9	Borrow Site	9.6	220,000	0	OW/WL
10	Borrow Site	4.8	65,000	0	OW/WL
11	Borrow Site	1.8	275,000	0	OW/WL
12	Sedimentation Facility	2.5	0	0	OW/WL
13	Dissemination Area	0.8	0	20	WL
14	Dissemination Area	2.7	0	20	WL
15	Topsoil Stockpile	2.4	0	200,000	WL
16	Personnel Camp	5.7	41,000	36,000	WL
17	Process Area(2)	34.2	535,000	1,000,000	UL/OW
18	Batch Plant	2.1	37,500	35,000	WL
19	Mine Water Ponds/Sedimentation Ponds	6.0	14,500	12,300	OW/WL
20	Upper Portals	6.0	0	0	UL
	TOTALS (3)	250.80	3,311,500	19,322,520	

FOOTNOTES:

1 - DTF will be uplands with the exception of the diversion areas which will be open water with some fringe wetlands.

2 - Diversions will be open water with some fringe wetlands.

3 - Additional fill is produced as development rock and tailings during mining operations.

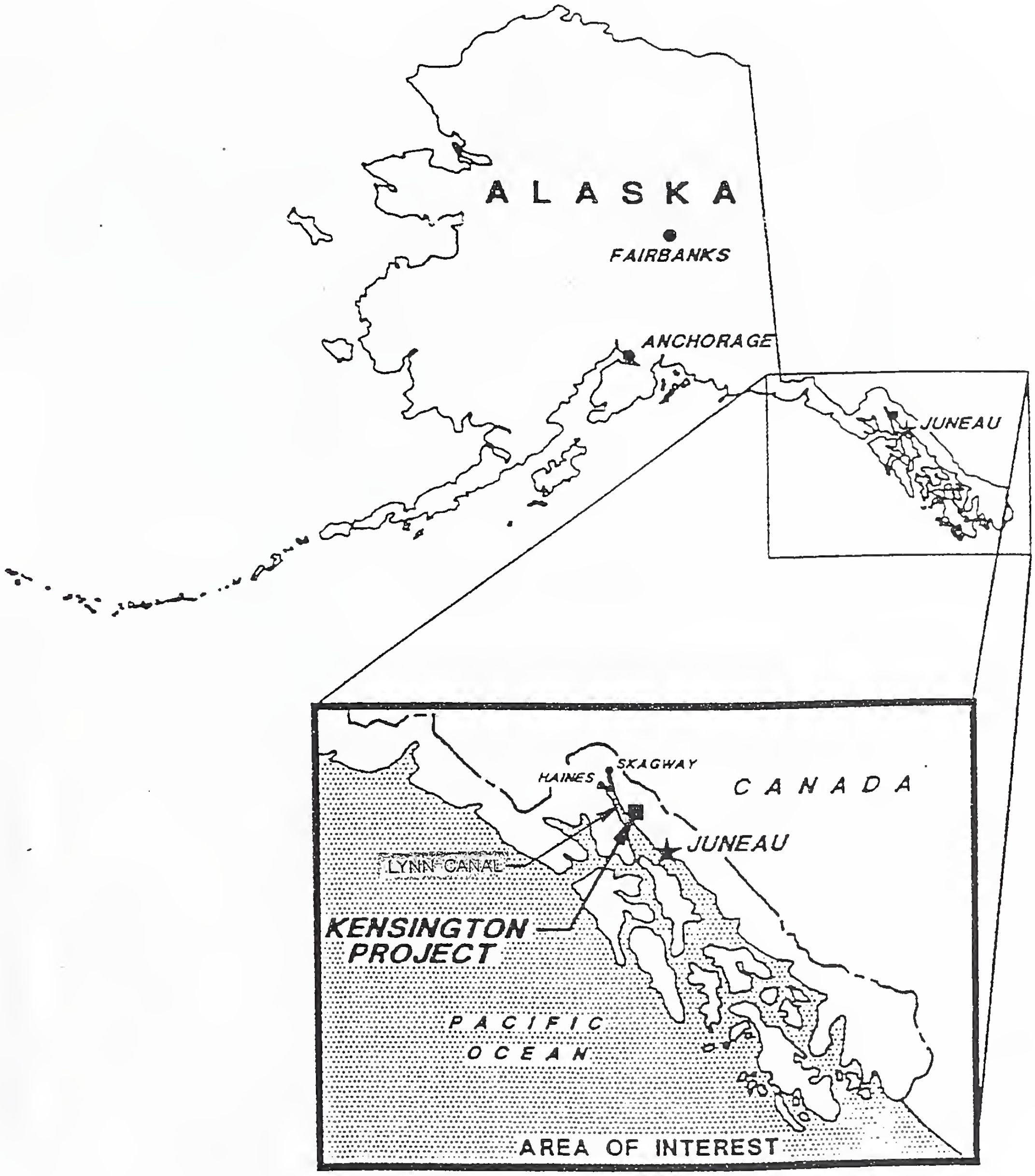
OW = Open water with fringe wetlands

UL = Uplands

WL = Wetlands

ML = Marine Lands

LIST OF SHEETS



REFERENCE:
AFTER DRAWING TITLED: "LOCATION MAP" BY ACZ INC., DATED: MAY 20, 1991.

STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
77202	01/96	A

SHEET 1 OF 40

SITE LOCATION MAP
KENSINGTON PROJECT

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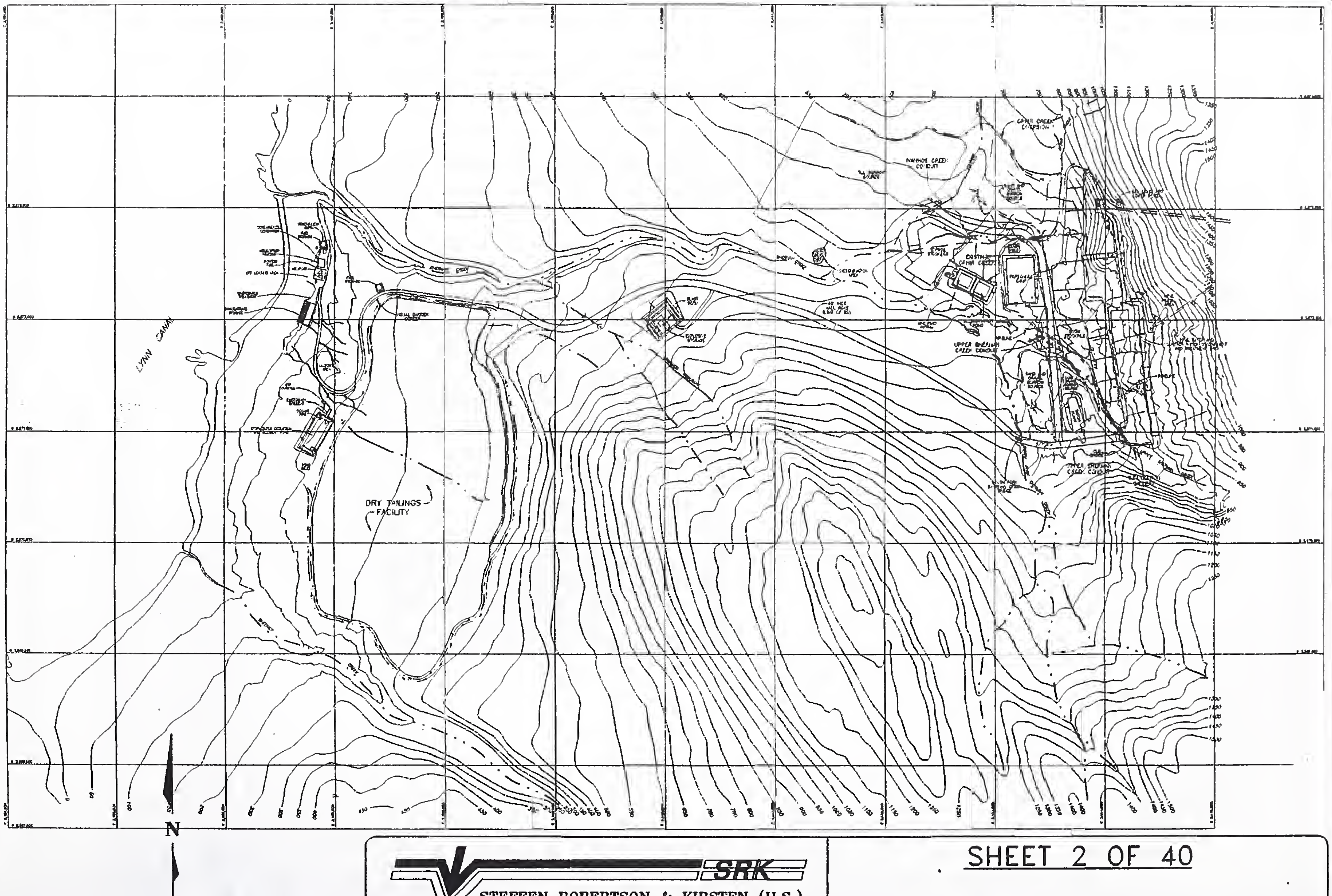

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STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
77203	01/97	A

SHEET 2 OF 40

GENERAL FACILITIES ARRANGEMENT

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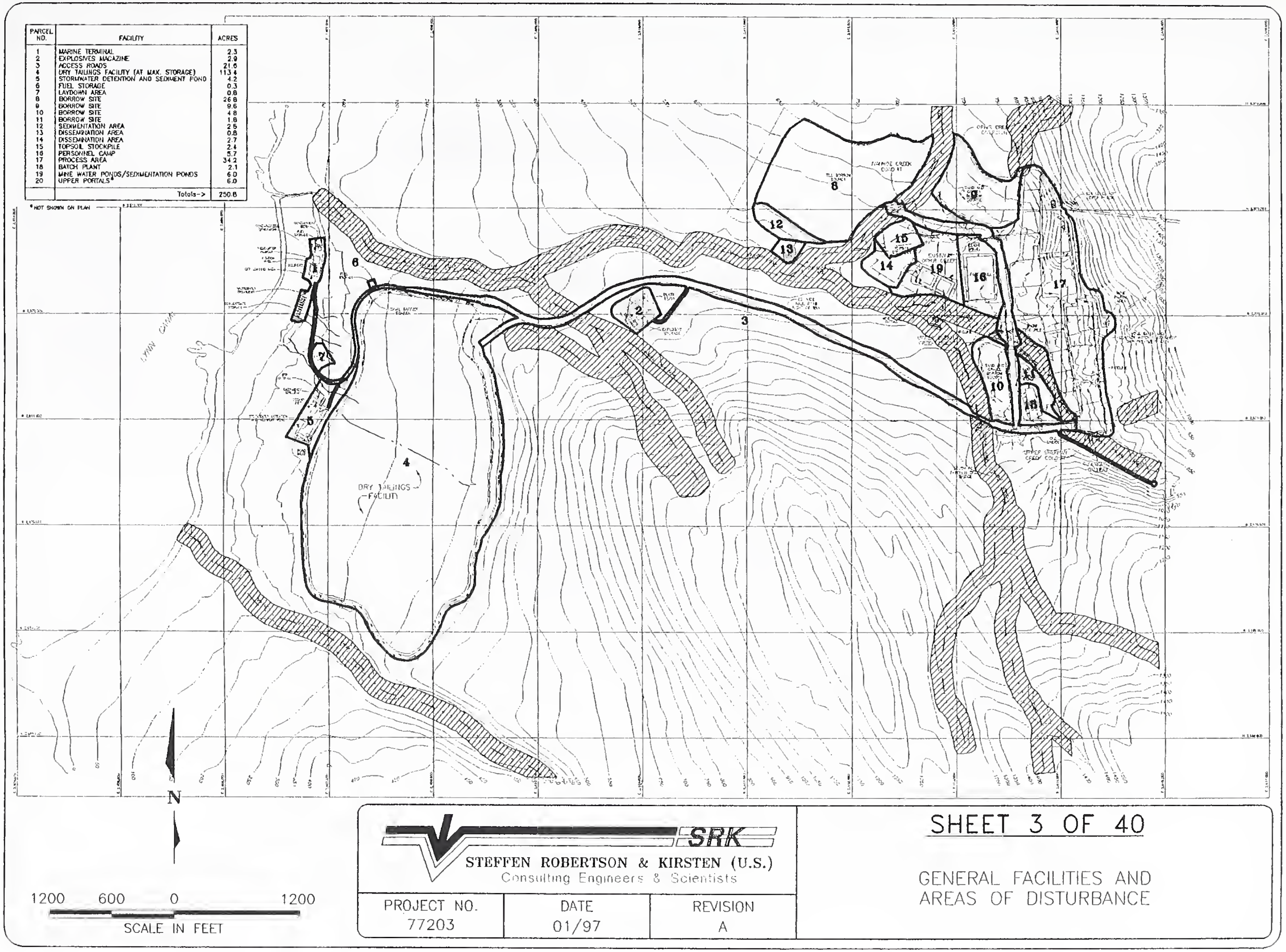
PARCEL NO.	FACILITY	ACRES
1	MARINE TERMINAL	2.3
2	EXPLOSIVES MAGAZINE	2.9
3	ACCESS ROADS	21.6
4	DRY TAILINGS FACILITY (AT MAX. STORAGE)	113.4
5	STORMWATER DETENTION AND SEDIMENT POND	4.2
6	FUEL STORAGE	0.3
7	LAYDOWN AREA	0.8
8	BORROW SITE	26.8
9	BORROW SITE	9.6
10	BORROW SITE	4.8
11	BORROW SITE	1.8
12	SEDIMENTATION AREA	2.5
13	DISSEMINATION AREA	0.8
14	DISSEMINATION AREA	2.7
15	TOPSOIL STOCKPILE	2.4
16	PERSONNEL CAMP	5.7
17	PROCESS AREA	34.2
18	BATCH PLANT	2.1
19	MINE WATER PONDS/SEDIMENTATION PONDS	6.0
20	UPPER PORTALS*	6.0
	Totals->	250.8

* NOT SHOWN ON PLAN



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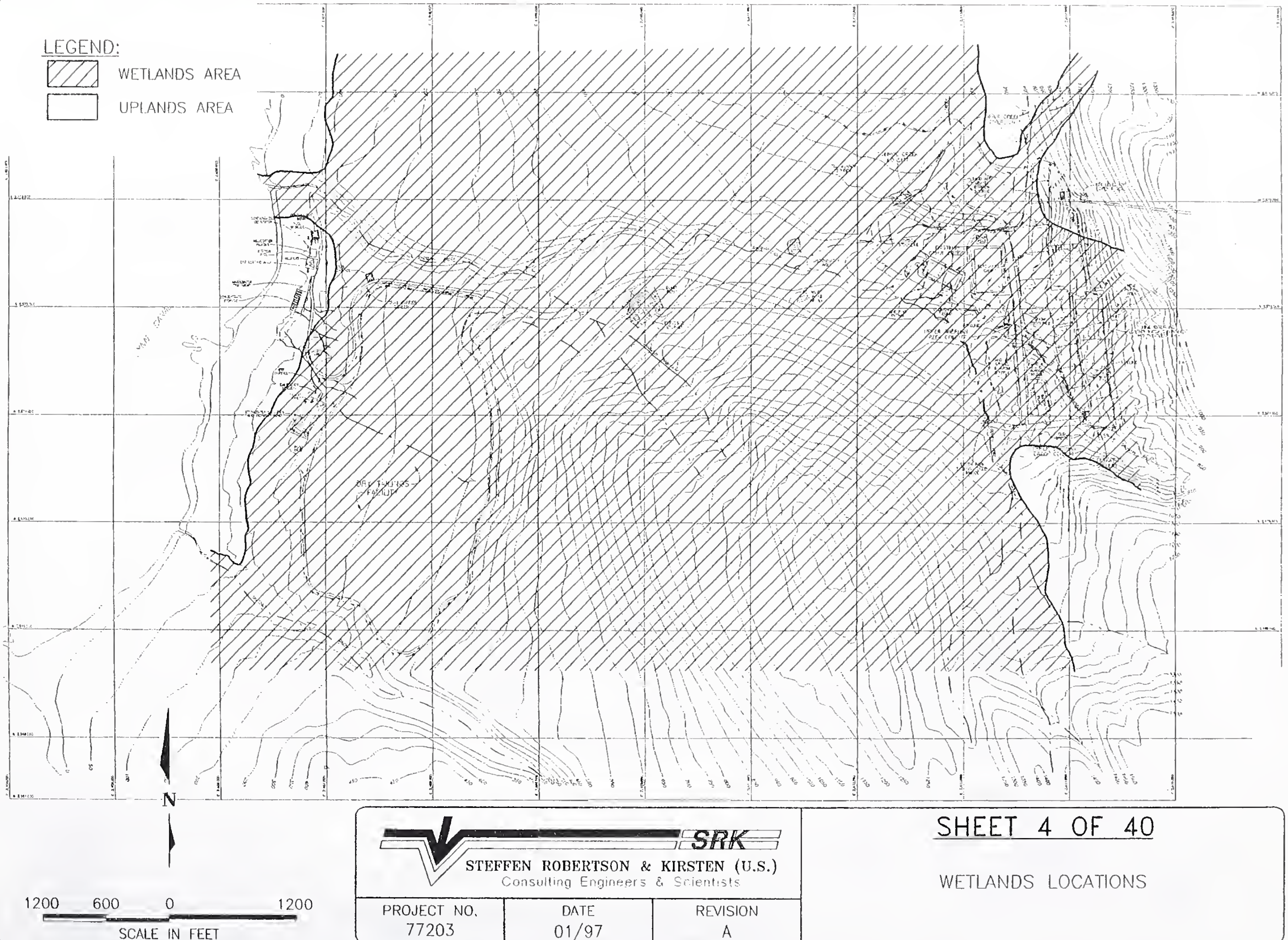
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
77203	01/97	A

SHEET 3 OF 40

GENERAL FACILITIES AND AREAS OF DISTURBANCE



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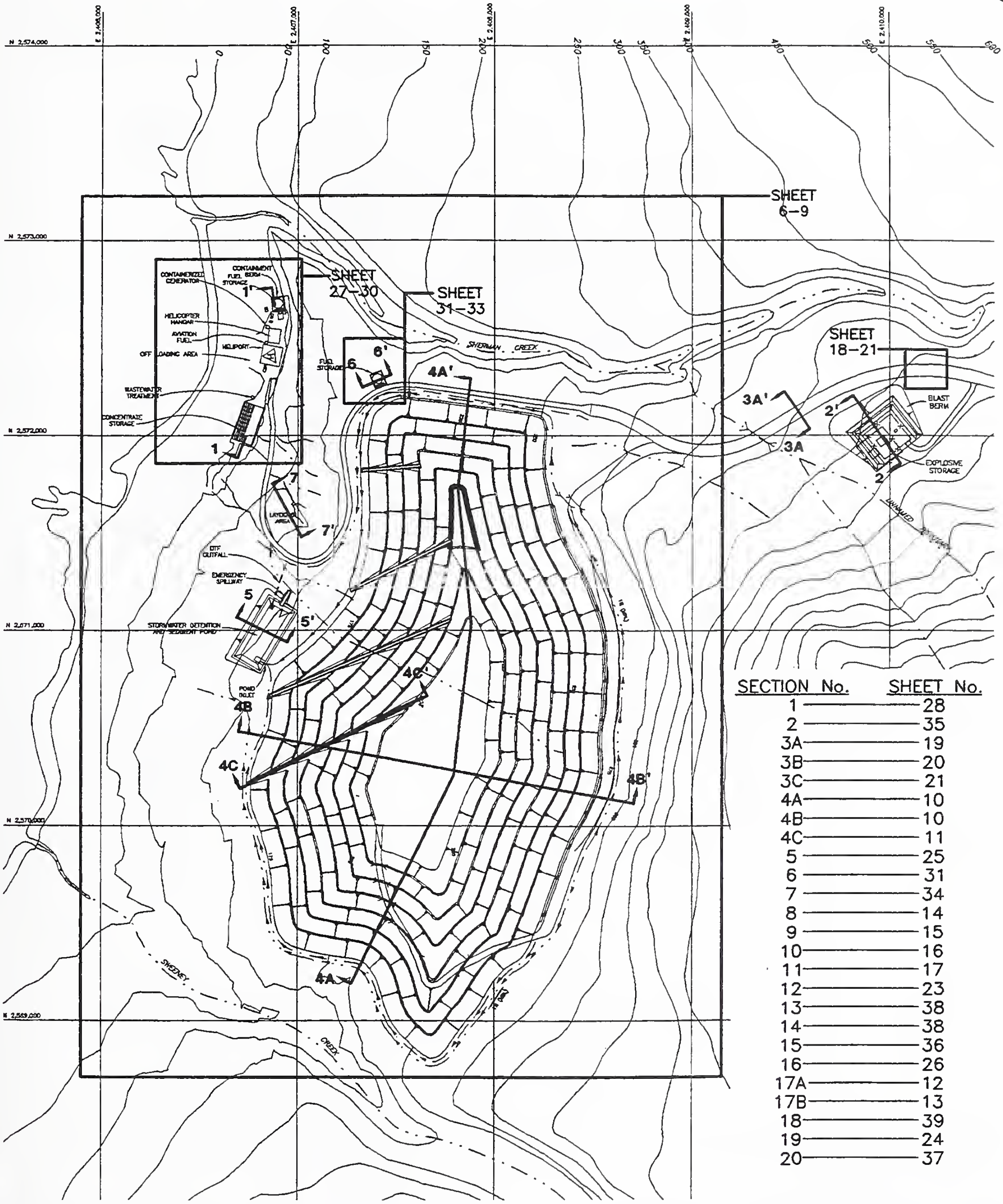
SHEET 4 OF 40

WETLANDS LOCATIONS



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SHEET INDEX FOR
DTF AREA

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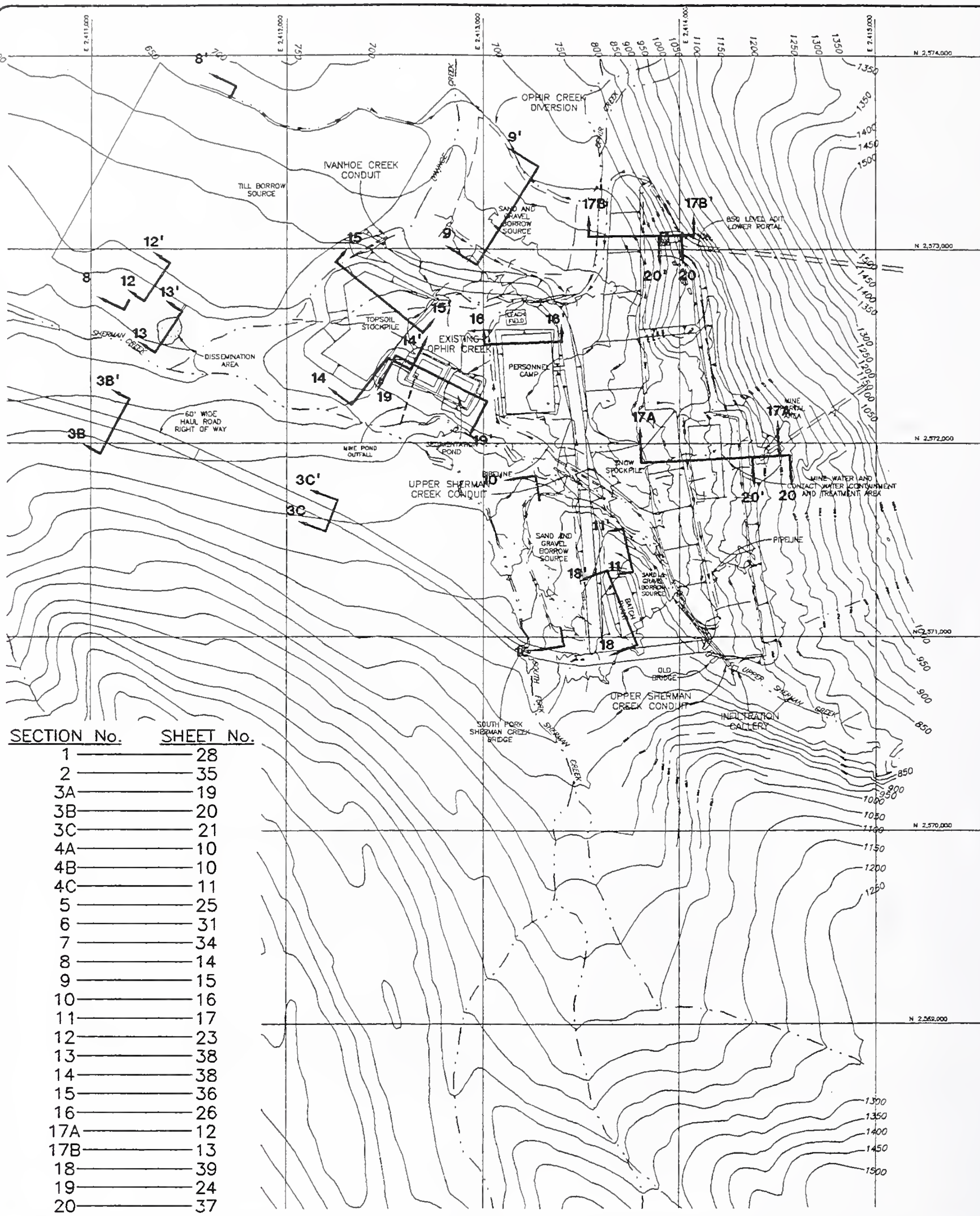

SECTION No.	SHEET No.
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3A	19
3B	20
3C	21
4A	10
4B	10
4C	11
5	25
6	31
7	34
8	14
9	15
10	16
11	17
12	23
13	38
14	38
15	36
16	26
17A	12
17B	13
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19	24
20	37

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Consulting Engineers & Scientists

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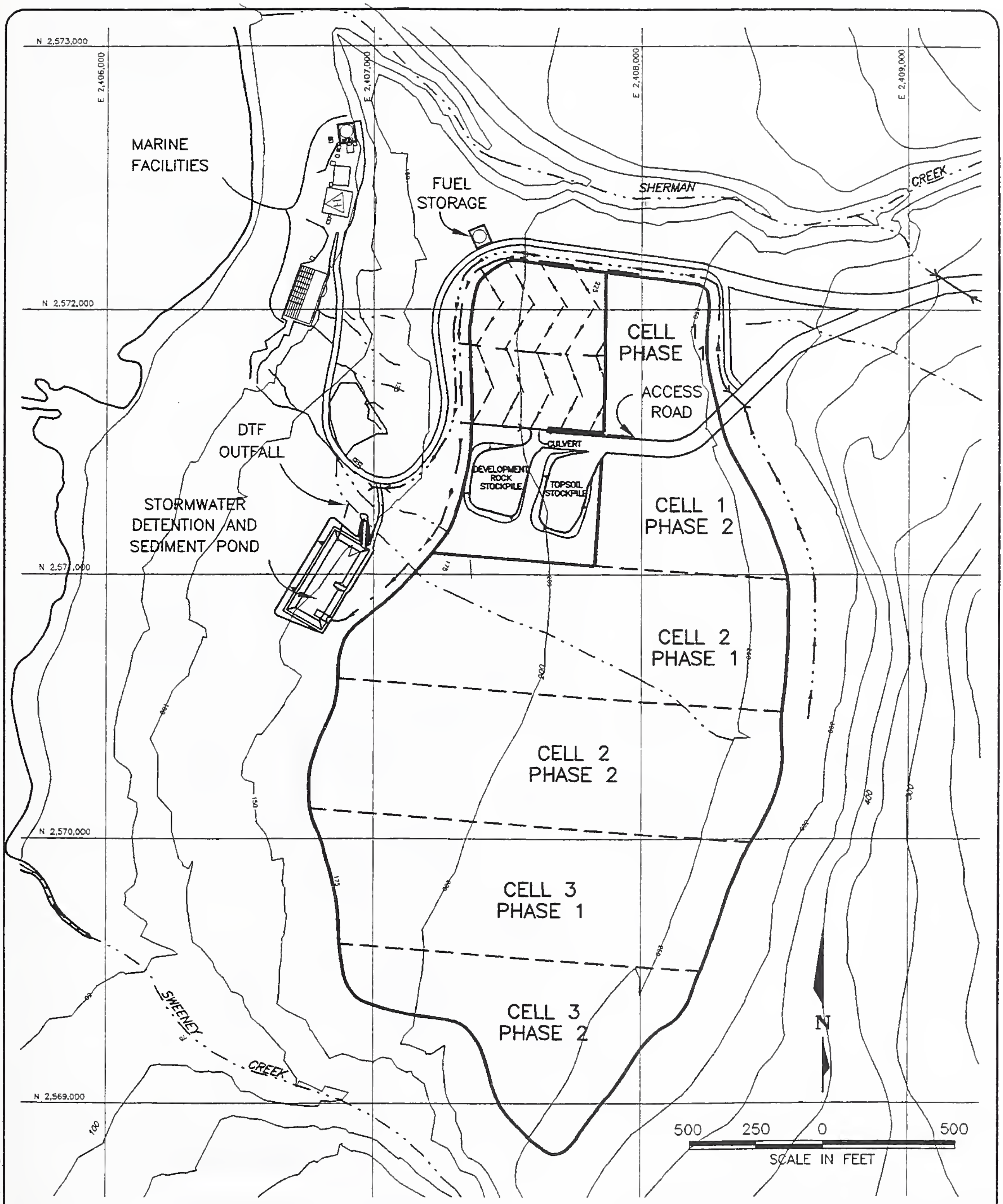
SHEET INDEX FOR PROCESS AREA

* STA.#2 ..\0772\77203\404APP\1-97\SHT05B.DWG * JAN 15, 1997 * 9:14:52 AM *



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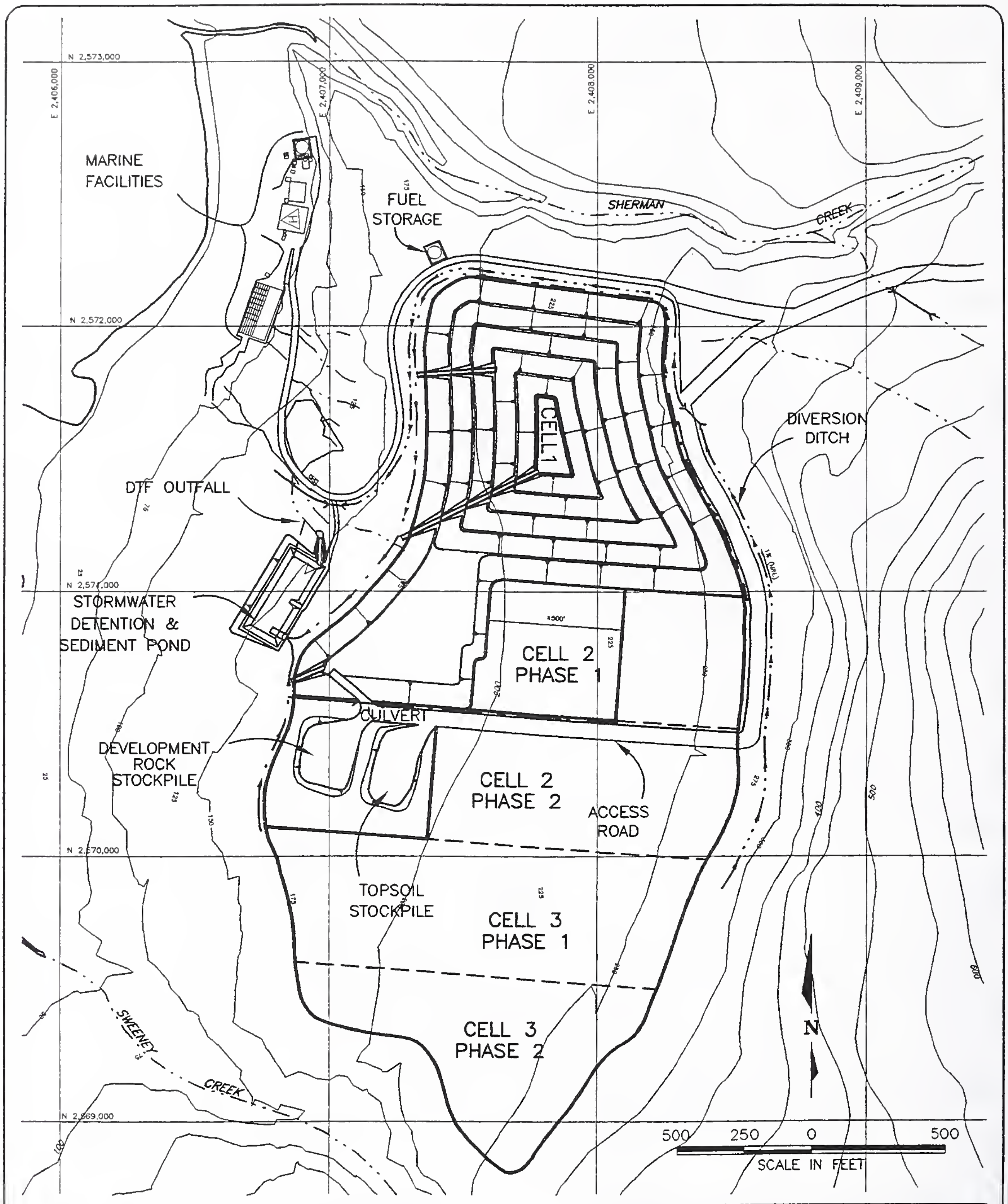
PROJECT NO.	DATE	REVISION
77203	12/96	A

SHEET 6 OF 40

DRY TAILINGS FACILITY
INITIAL CONSTRUCTION

* STA.ℓ I:\0772\77203\404APP\1-97\SHT06.DWG * JAN 10, 1997 * 2:37:39 PM *



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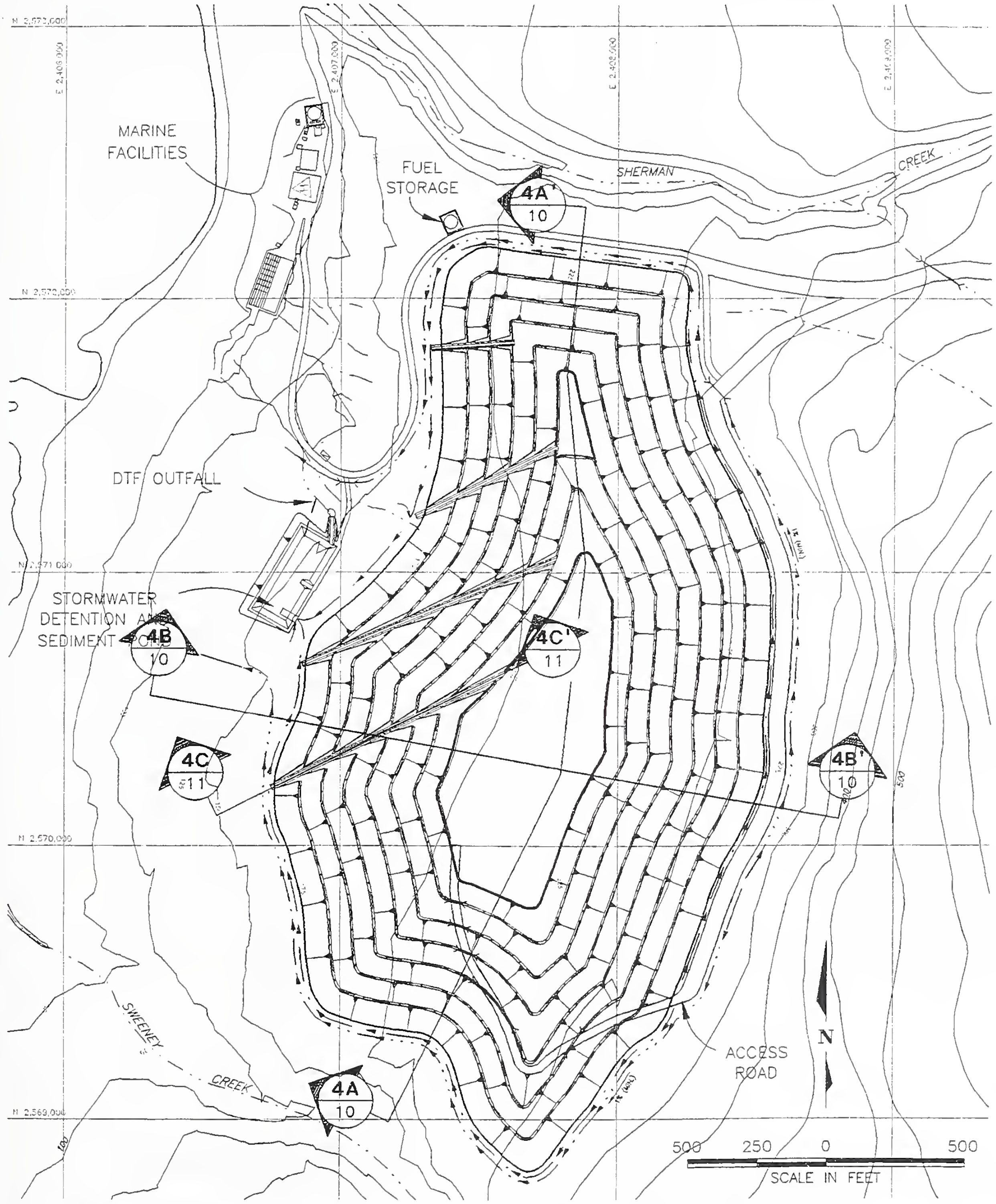
DRY TAILINGS FACILITY
CELL 1 DEVELOPMENT

* STA.#1 \0772\77203\404APP\1-97\SHT07.DWG * JAN 10, 1997 * 2:38:59 PM *



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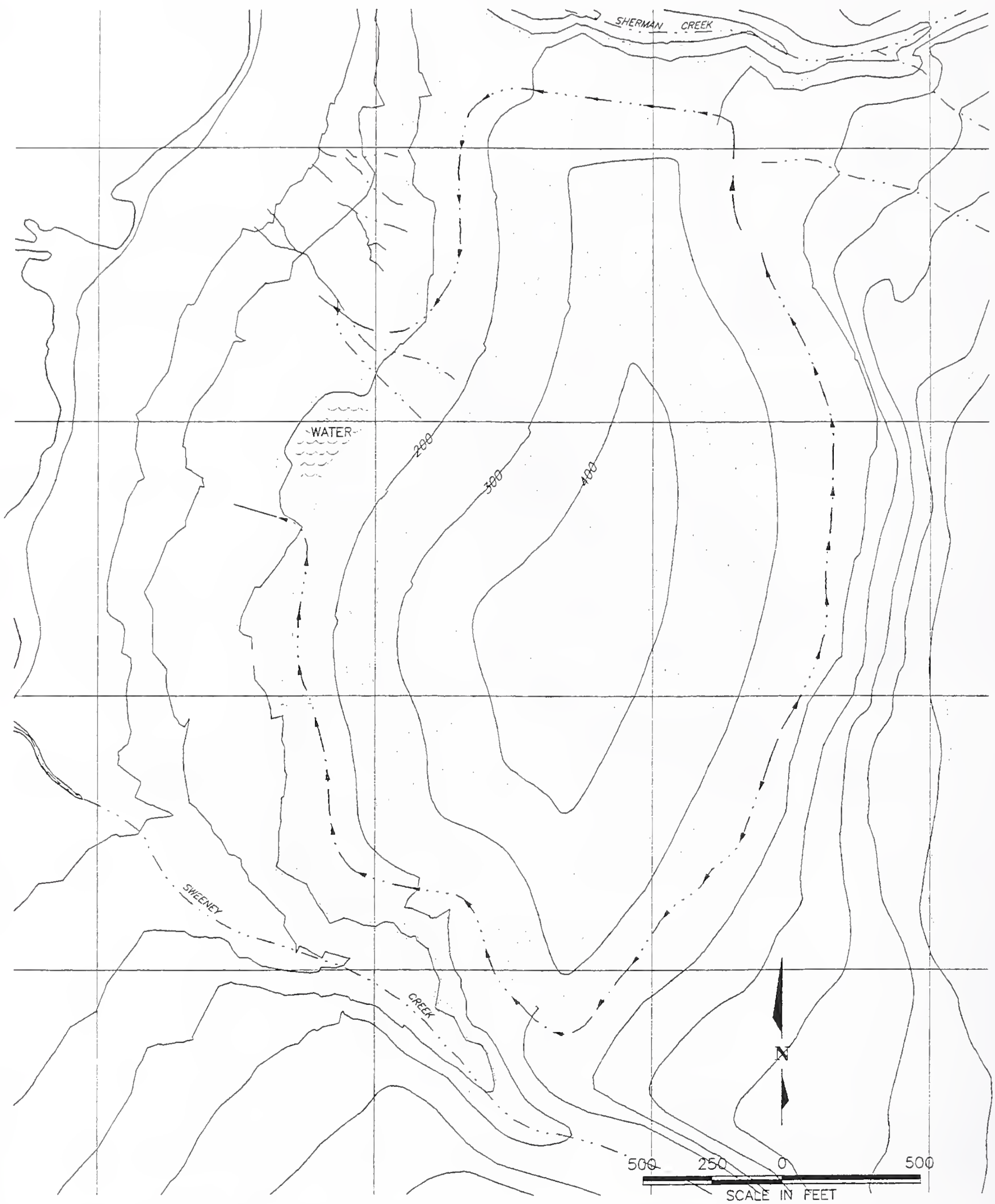
DRY TAILINGS FACILITY
FINAL CONFIGURATION

* STA #1 ...\0772\77203\404APP\1-97\SHTC8.DWG * JAN 10, 1997 * 4:05:20 PM *



\0772\77203\404APP\1-97\SH109.DWG • JAN 10, 1997 • 4:14:45 PM •

• STA #

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STEFFEN ROBERTSON & KIRSTEN (U.S.)
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PROJECT NO.	DATE	REVISION
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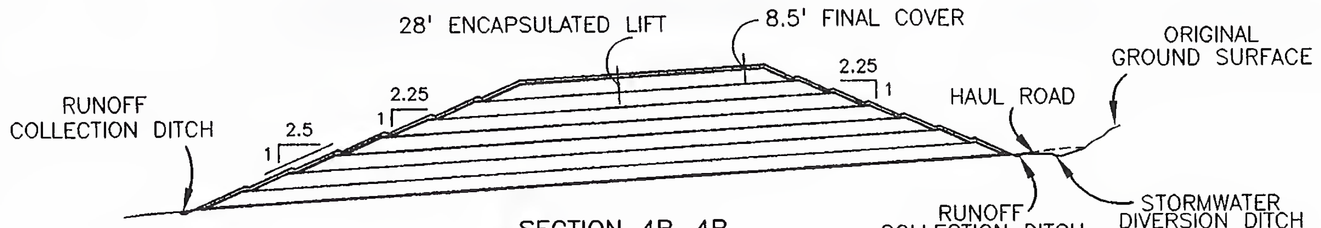
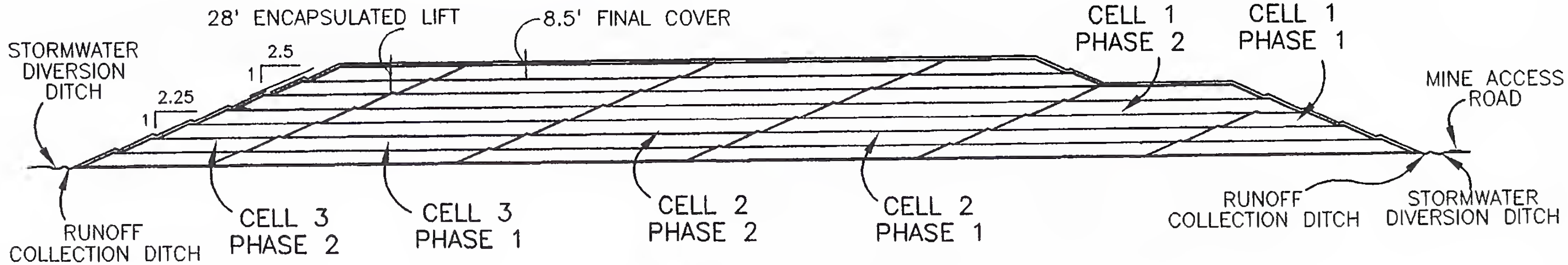
RECLAIMED
DRY TAILINGS FACILITY

* STA. M:\0772\77203\404APP\1-97\SHT10.DWG • JAN 10, 1997 • 3:11:57 PM •



SECTION 4B–4B
DRY TAILINGS FACILITY
NOT TO SCALE



SECTION 4A–4A
DRY TAILINGS FACILITY
NOT TO SCALE

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DRY TAILINGS FACILITY
SECTION 4A–4A AND 4B–4B

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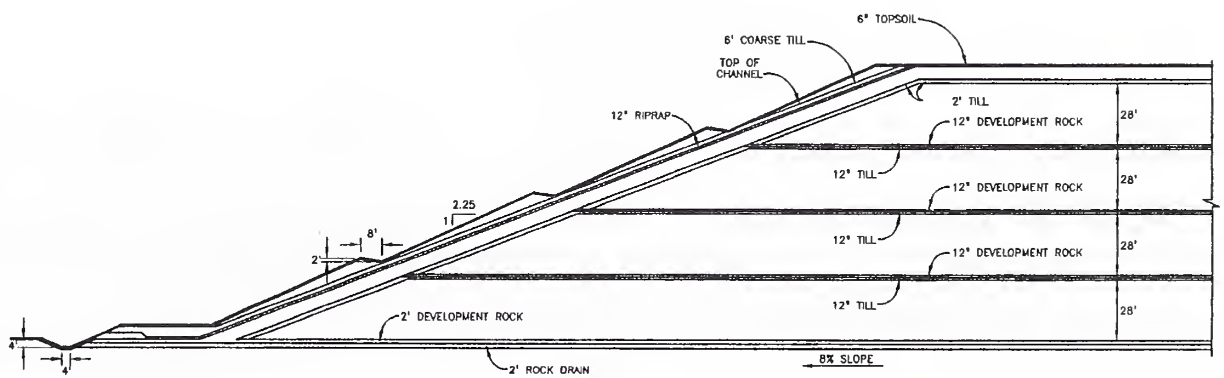
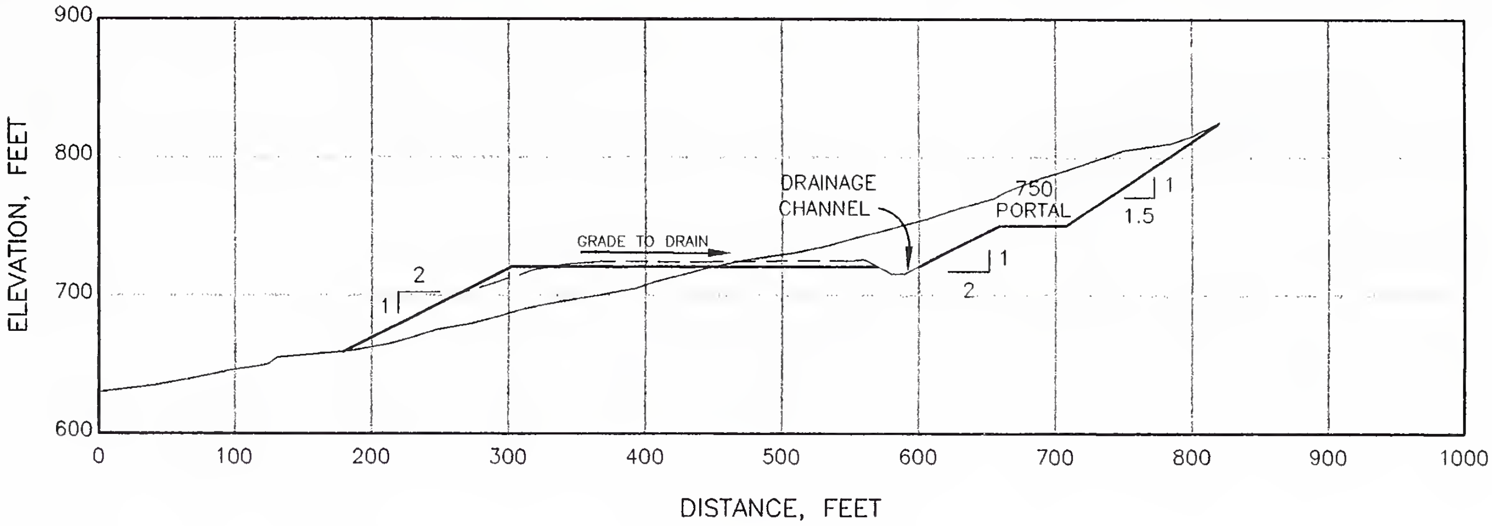


SECTION 4C-4C
DOWN CHUTE SECTION
(NOT TO SCALE)

SRK STEFFEN ROBERTSON & KIRSTEN (U.S.) Consulting Engineers & Scientists			SHEET 11 OF 40
PROJECT NO. 77203	DATE 01/97	REVISION A	SECTION 4C-4C DOWNCHUTE SECTION AT DTF

* STA.# :\0772\77203\404APP\1--97\SHT12.DWG • JAN 10, 1997 • 2:44:18 PM •



LEGEND:
- – – – RECLAIMED SURFACE
- ——— OPERATIONAL SURFACE
- ——— NATURAL GROUND SURFACE

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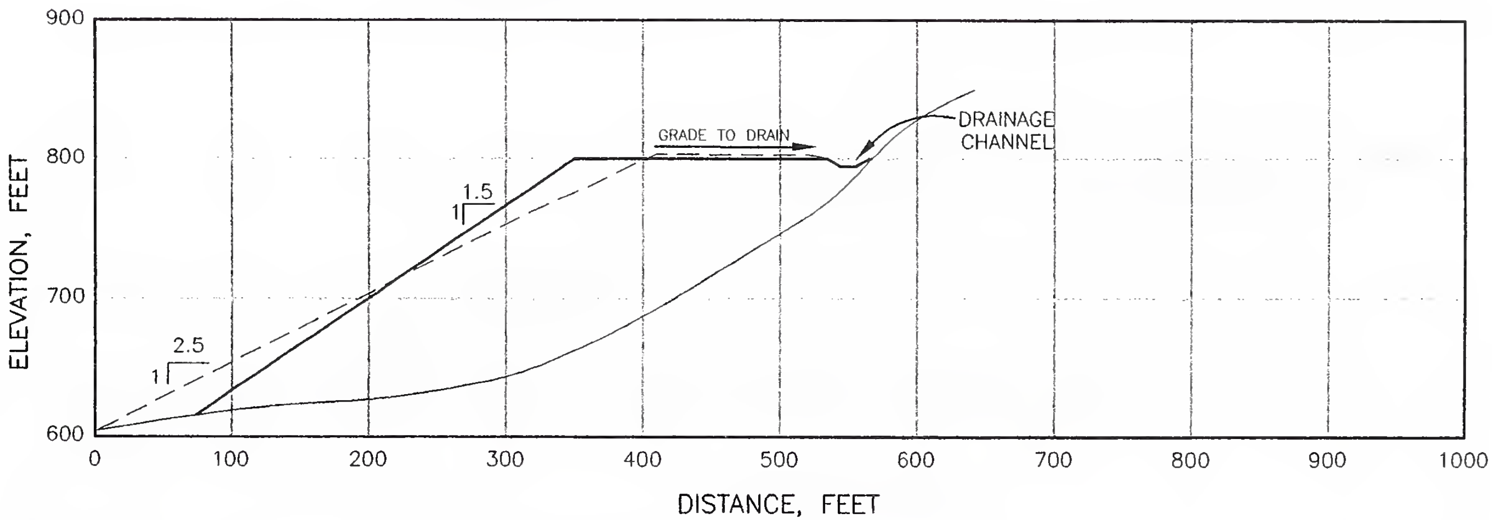
SECTION 17A–17A
PROCESS AREA
AT 750 PORTAL

* STA.#. .\0772\77203\404APP\1-97\SHT13.DWG * JAN 10, 1997 * 2:45:18 PM *



LEGEND:

- – – – RECLAIMED SURFACE
- ——— OPERATIONAL SURFACE
- ——— NATURAL GROUND SURFACE

SRK

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PROJECT NO.	DATE	REVISION
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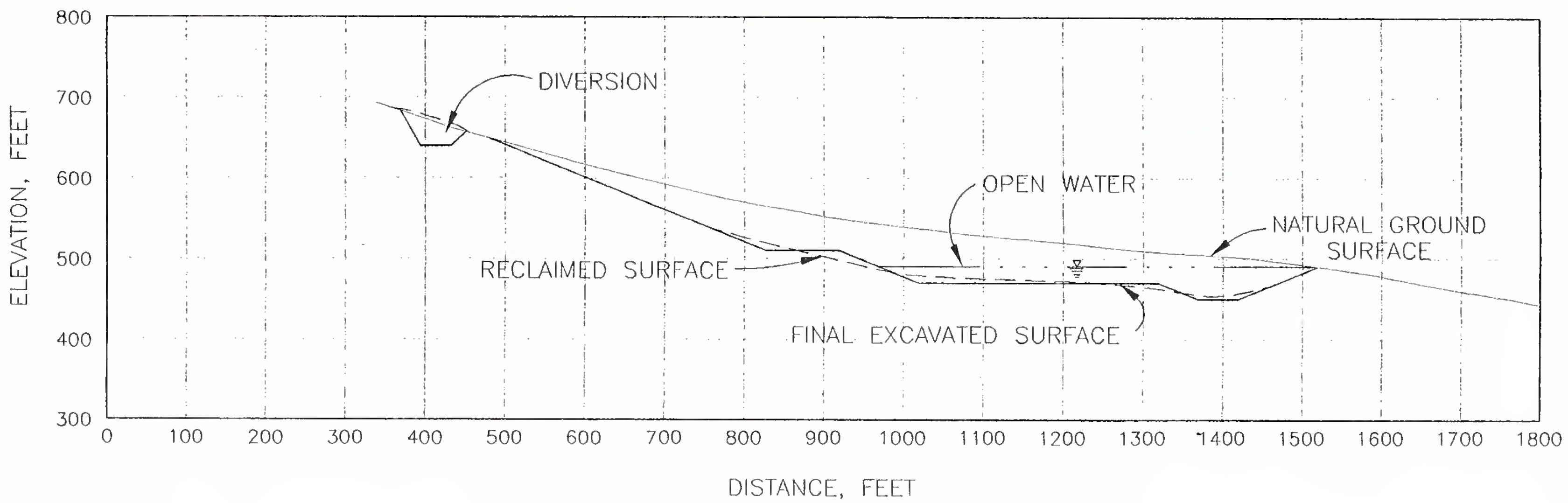
SECTION 17B–17B
PROCESS AREA
AT 850 PORTAL

* STA.# \0772\77203\404APP\1-97\SHT14.DWG • JAN 10, 1997 • 4:17:37 PM •



LEGEND:

- — — — RECLAIMED SURFACE
- ——— FINAL EXCAVATED SURFACE
- ——— NATURAL GROUND SURFACE

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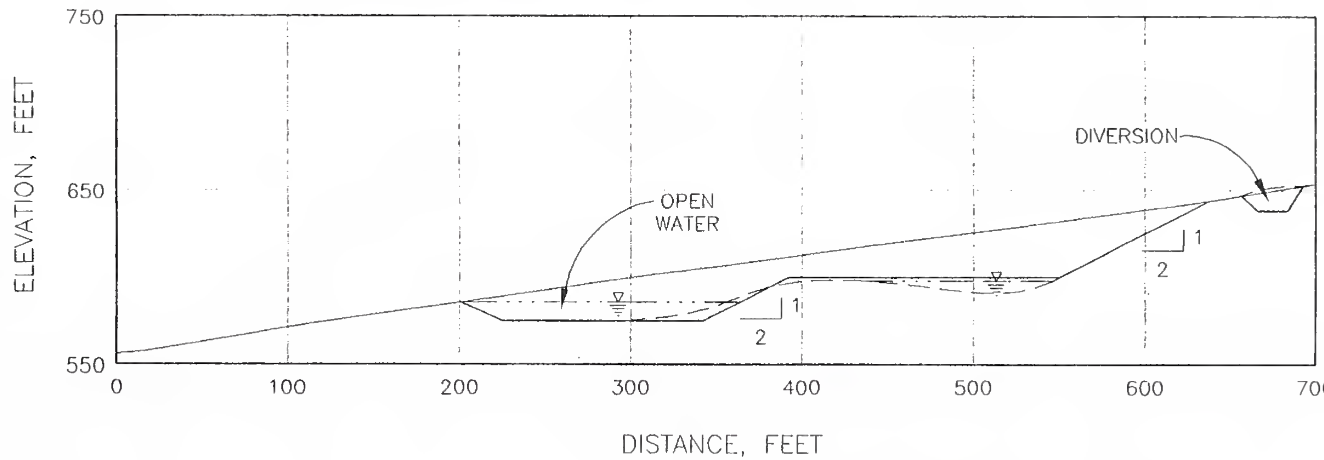
SECTION 8-8
BORROW SITE – TILL

* STA.#1 \0772\77203\404APP\1-97\SHT15.DWG * JAN 10, 1997 * 4:19:04 PM *



LEGEND:

- — — — RECLAIMED SURFACE
- ——— FINAL EXCAVATED SURFACE
- ——— NATURAL GROUND SURFACE

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Consulting Engineers & Scientists

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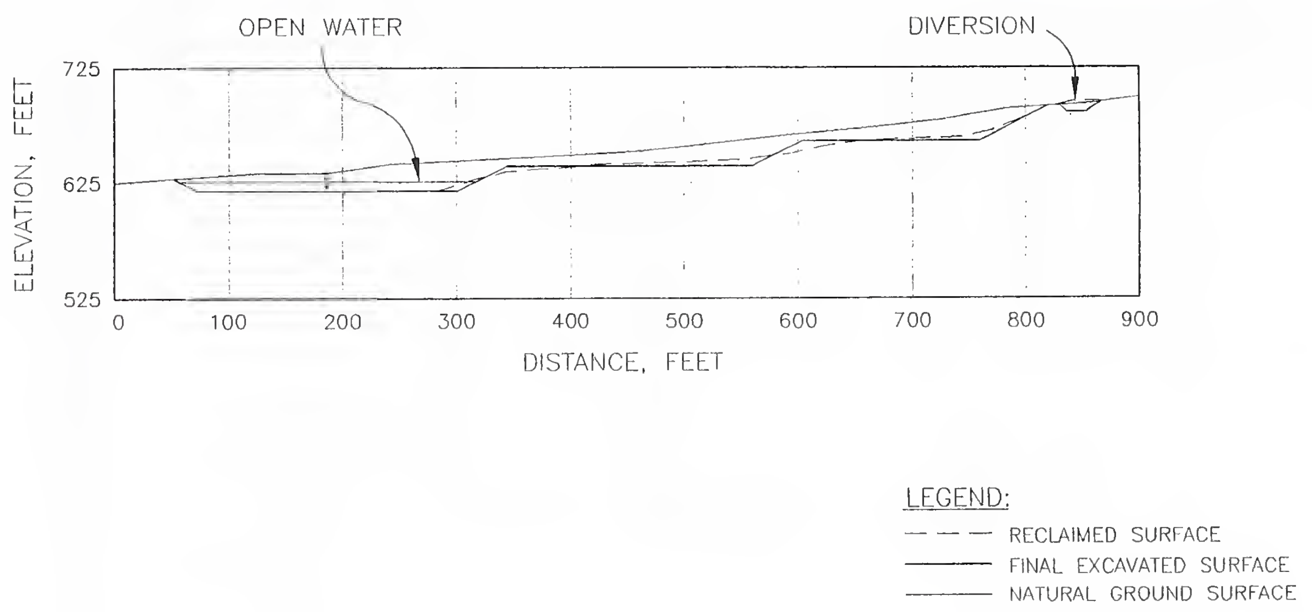
SECTION 9-9
BORROW SITE
SAND & GRAVEL
NORTH OF PERSONNEL CAMP



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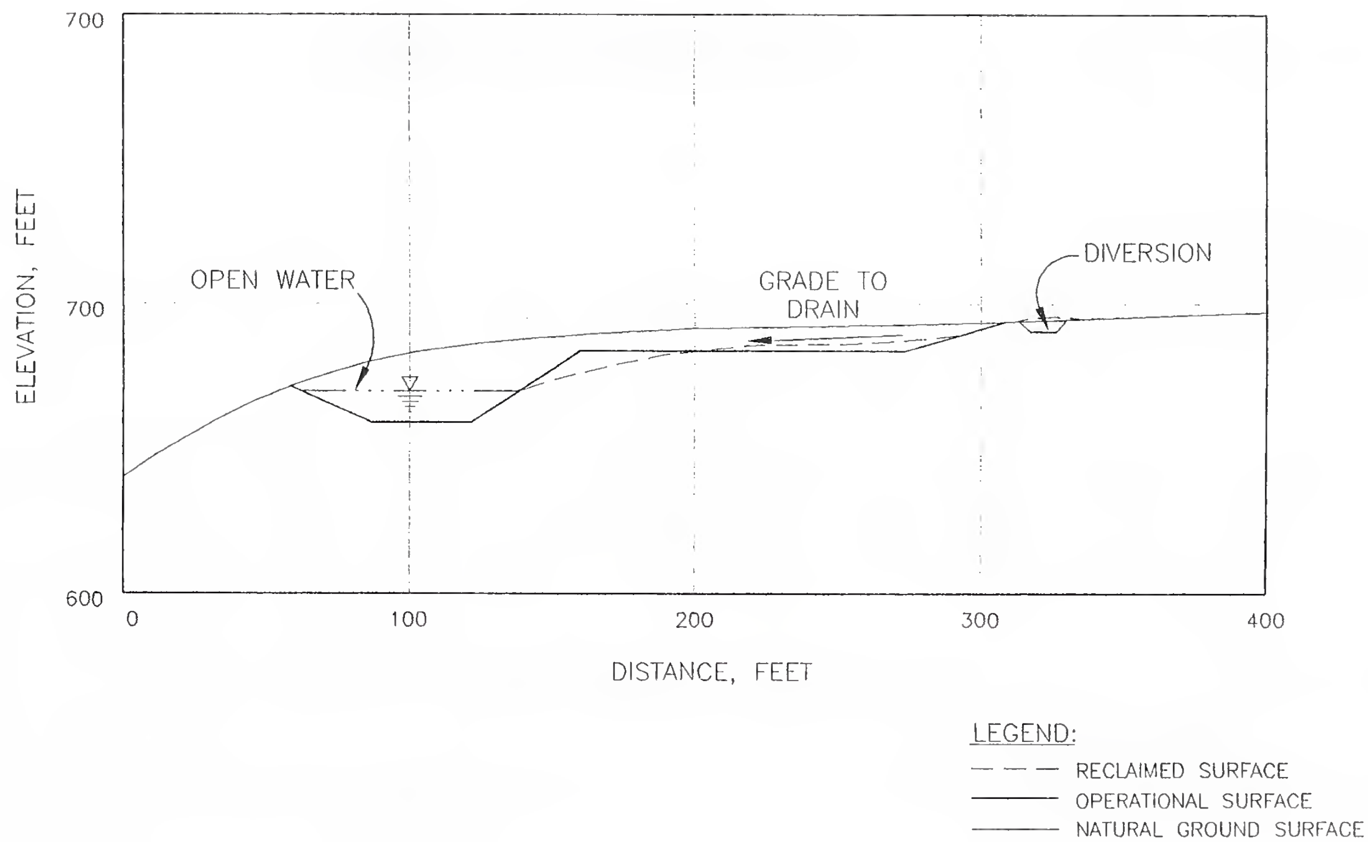
SECTION 10-10
BORROW SITE
SAND AND GRAVEL
WEST OF BATCH PLANT

• STA.#1 \0772\77203\404APP\1-97\SHT17.DWG • JAN 10, 1997 • 4:21:40 PM •



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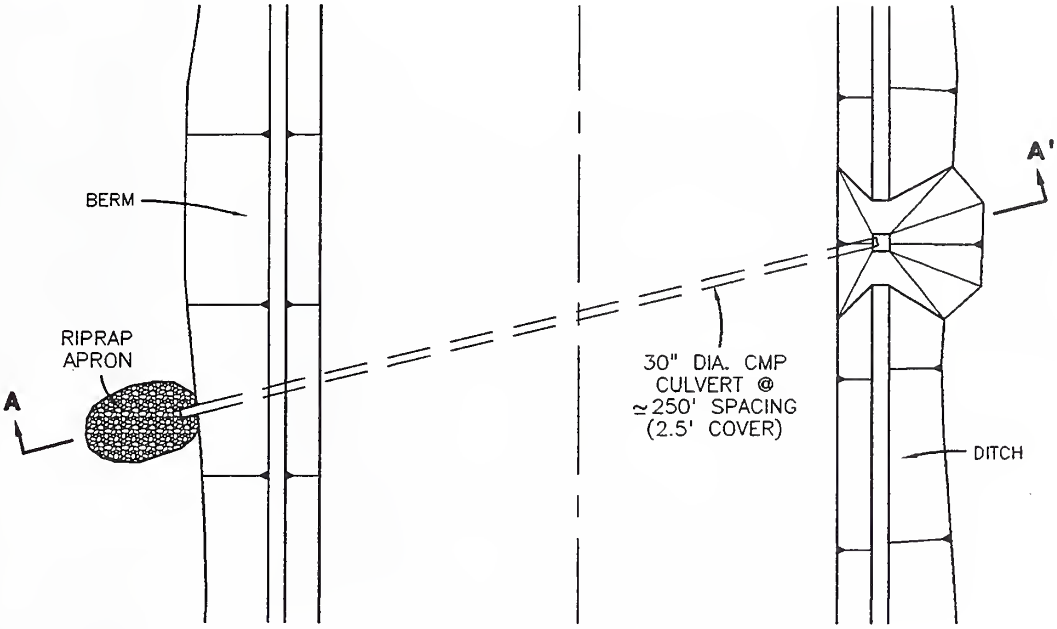
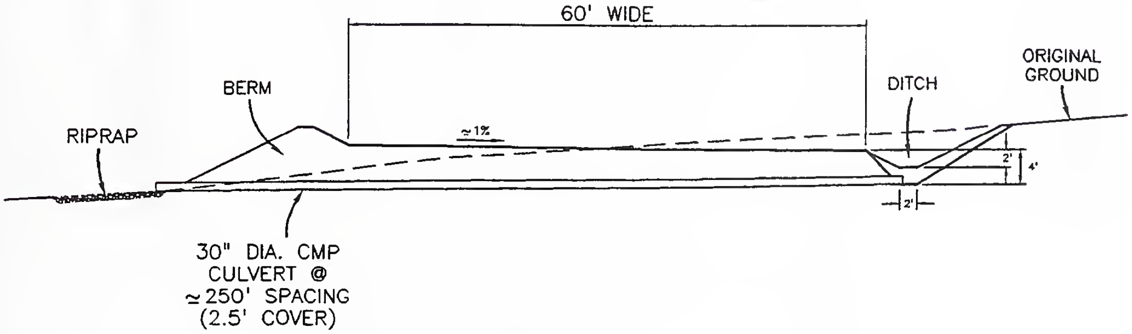
SECTION 11–11
BORROW SITE
SAND & GRAVEL
EAST OF BATCH PLANT



TYPICAL HAUL ROAD PLAN
NOT TO SCALE



TYPICAL HAUL ROAD SECTION A–A'
NOT TO SCALE

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PROJECT NO.	DATE	REVISION
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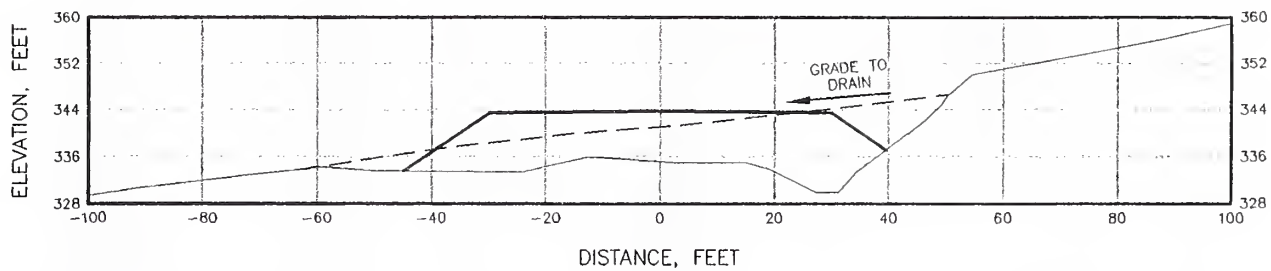
TYPICAL SECTION AND
PLAN OF ACCESS ROAD
AT CULVERT

* STA. I:\0772\77203\404APP\1-97\SHT18.DWG * JAN 10, 1997 * 12:33:10 AM *

* STA.# :\0772\77203\404APP\1-97\SHT19.DWG * JAN 10, 1997 * 12:35:37 AM *



LEGEND:

- — — — RECLAIMED SURFACE
- ——— OPERATIONAL SURFACE
- ——— NATURAL GROUND SURFACE

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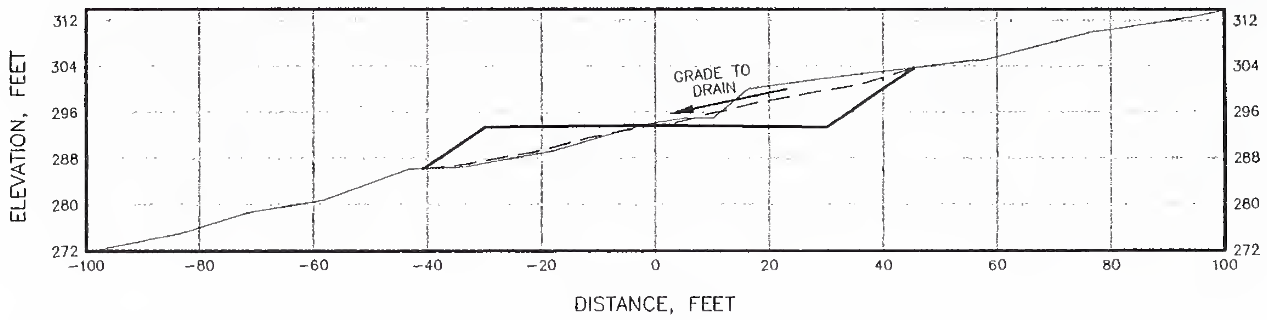
SECTION 3A–3A
ACCESS ROAD
TYPICAL FILL SECTION

* STA.# I:\0772\77203\404APP\1-97\SHT20.DWG * JAN 10, 1997 * 12:37:02 AM *



LEGEND:

- — — — RECLAIMED SURFACE
- ——— OPERATIONAL SURFACE
- ——— NATURAL GROUND SURFACE

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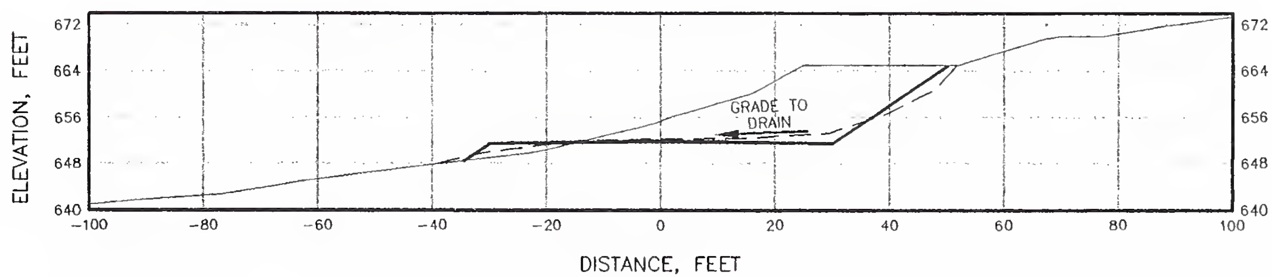
SECTION 3B-3B
ACCESS ROAD
TYPICAL CUT/FILL SECTION



LEGEND:

- RECLAIMED SURFACE
- OPERATIONAL SURFACE
- NATURAL GROUND SURFACE

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Consulting Engineers & Scientists

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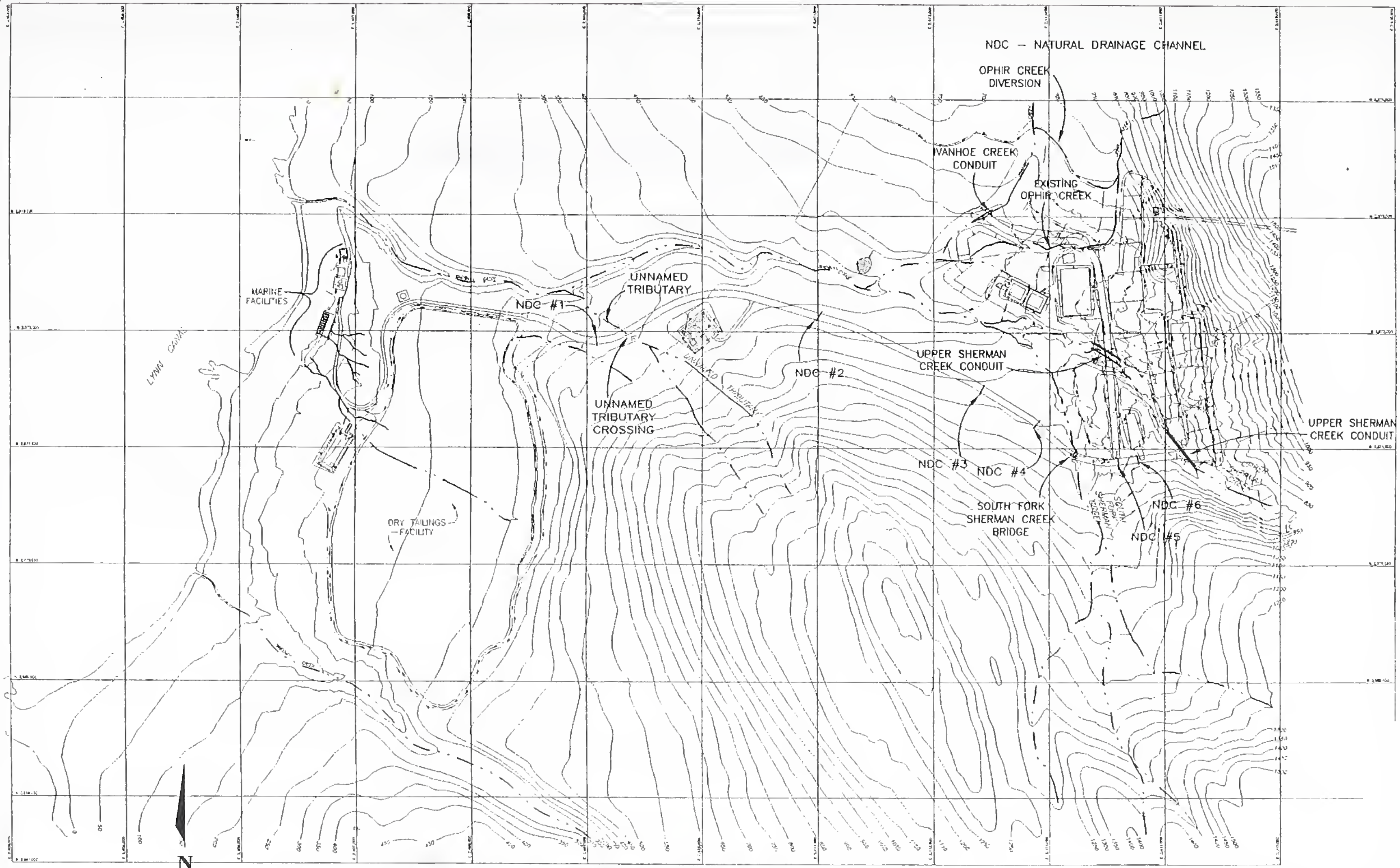
SECTION 3C-3C
ACCESS ROAD
TYPICAL CUT SECTION

+ STA ; 4:\0772\77203\404APP\1-97\SHT22.DWG + JAN 10, 1997 + 12:42:05 AM +



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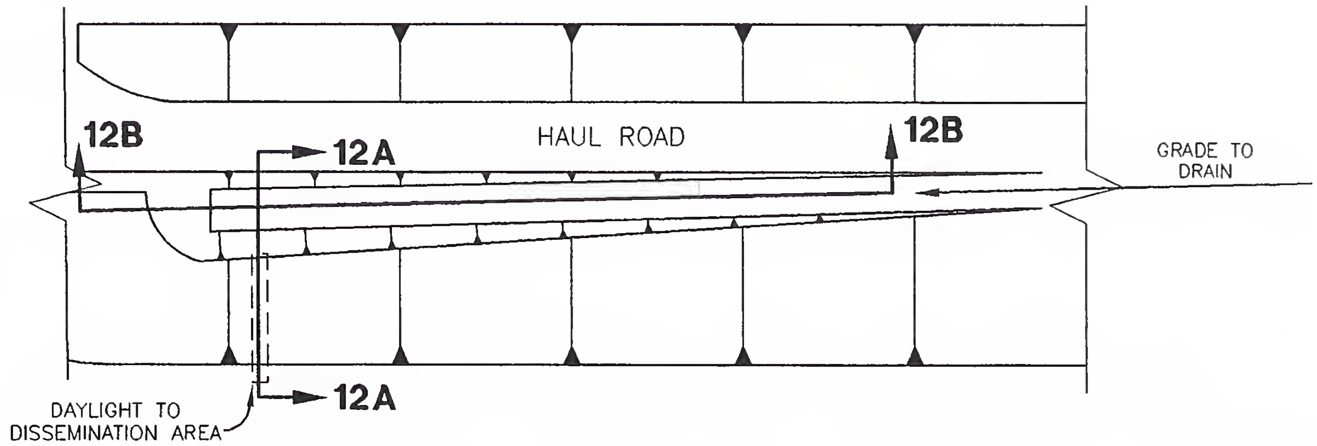
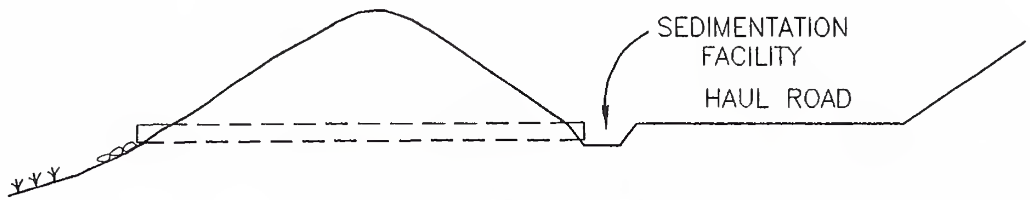
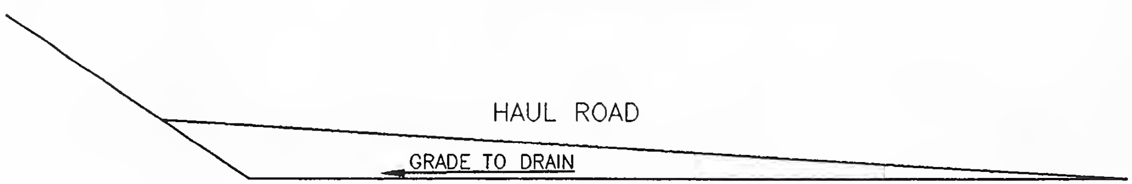
STREAM/DRAINAGE HAUL ROAD CROSSING SECTIONS

* STA.#. ι:\0772\77203\404APP\1-97\SHT23.DWG * JAN 10, 1997 * 12:51:28 AM *





SECTION 12A–12A
NOT TO SCALE



SECTION 12B–12B
NOT TO SCALE

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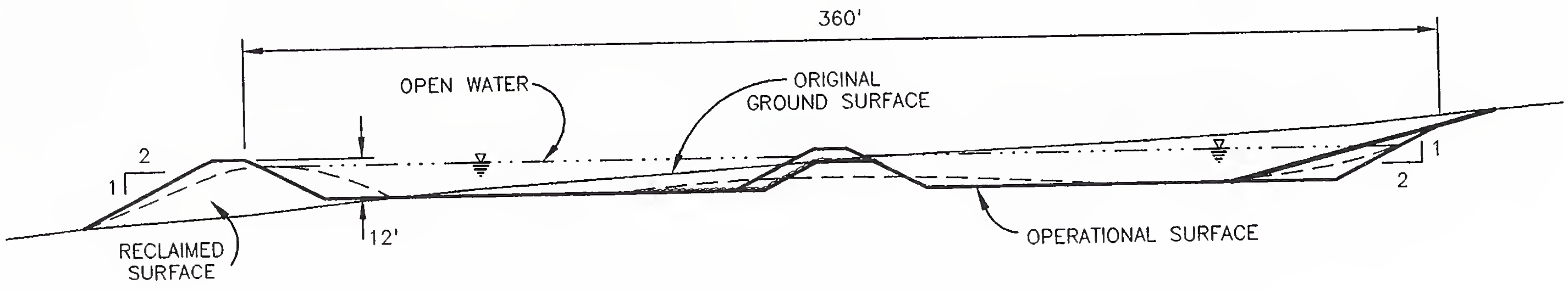
SECTION 12–12
SEDIMENTATION AREA

* STA.# A:\0772\77203\404APP\1-97\SHT24.DWG * JAN 10, 1997 * 12:54:12 AM *



LEGEND:
- RECLAIMED SURFACE
- OPERATIONAL SURFACE
- NATURAL GROUND SURFACE

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PROJECT NO.	DATE	REVISION
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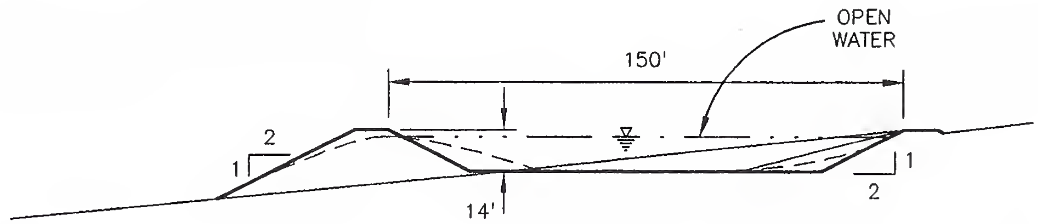
SECTION 19–19
MINE WATER PONDS/SEDIMENTATION PONDS

* STA.# I:\0772\77203\404APP\1-97\SHT25.DWG * JAN 10, 1997 * 12:58:02 AM *



LEGEND:

— — — RECLAIMED SURFACE
OPERATIONAL SURFACE
NATURAL GROUND SURFACE

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Consulting Engineers & Scientists

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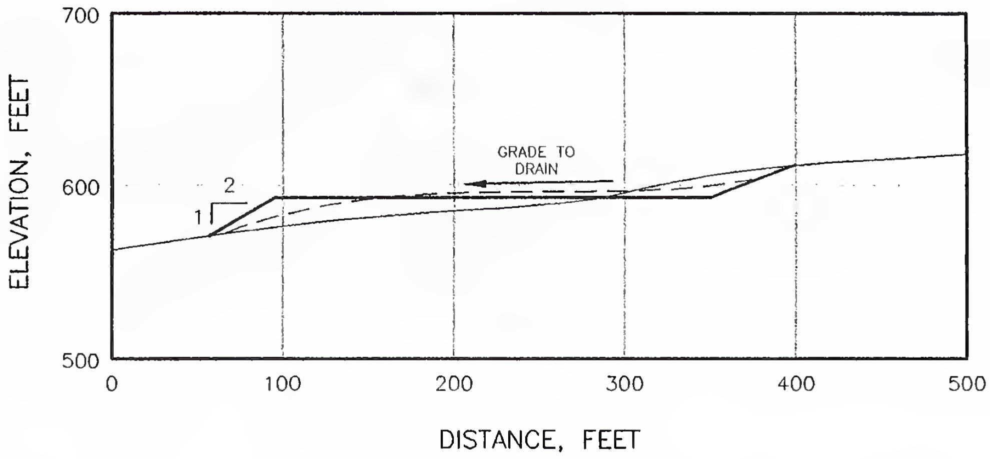
SECTION 5-5
STORMWATER DETENTION AND
SEDIMENTATION POND AT DTF

* STA., M:\0772\77203\404APP\1-97\SHT26.DWG * JAN 10, 1997 * 12:59:21 AM *



LEGEND:

- — — — RECLAIMED SURFACE
- ——— OPERATIONAL SURFACE
- ——— NATURAL GROUND SURFACE

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PROJECT NO.	DATE	REVISION
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SECTION 16-16
PERSONNEL CAMP

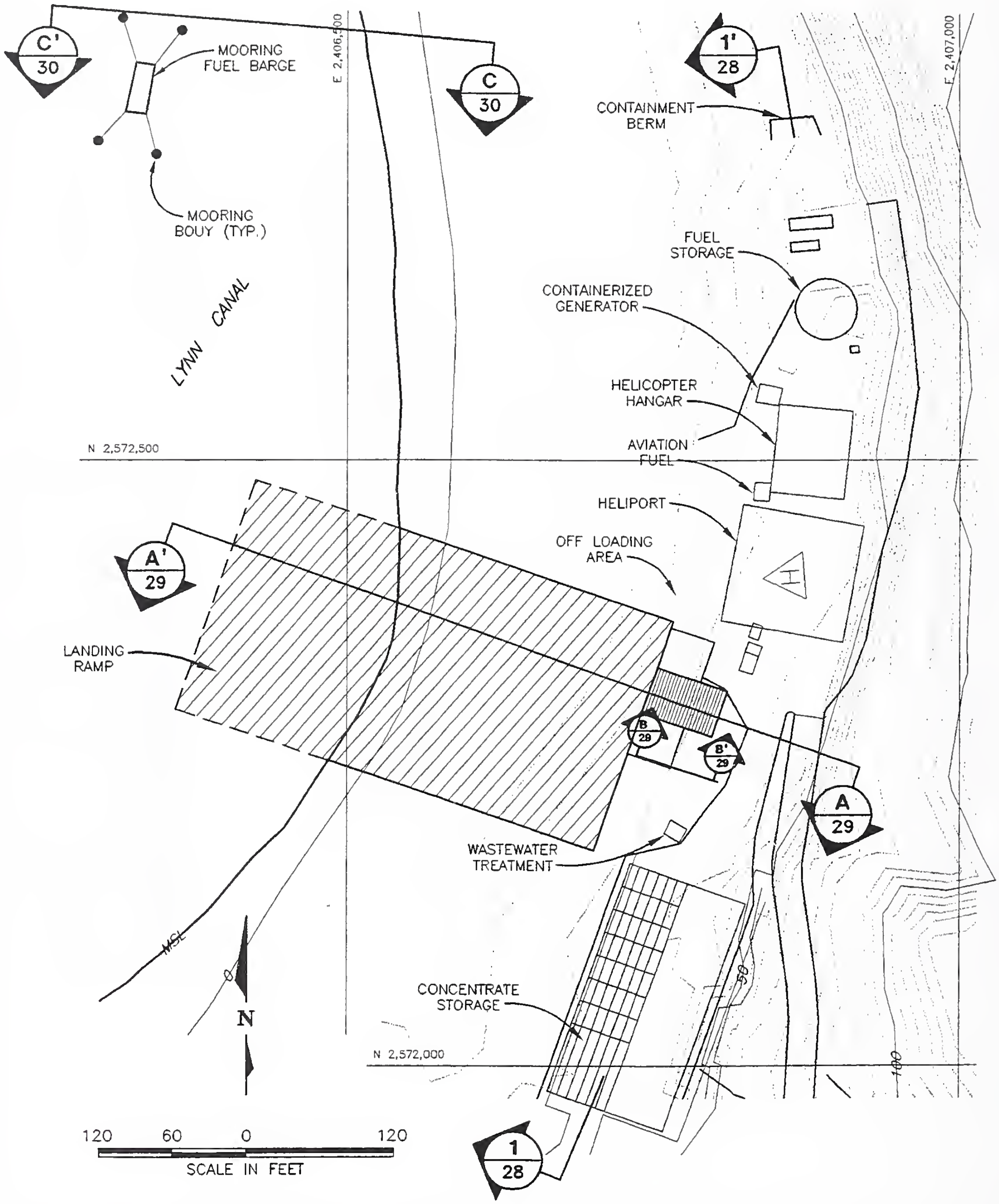

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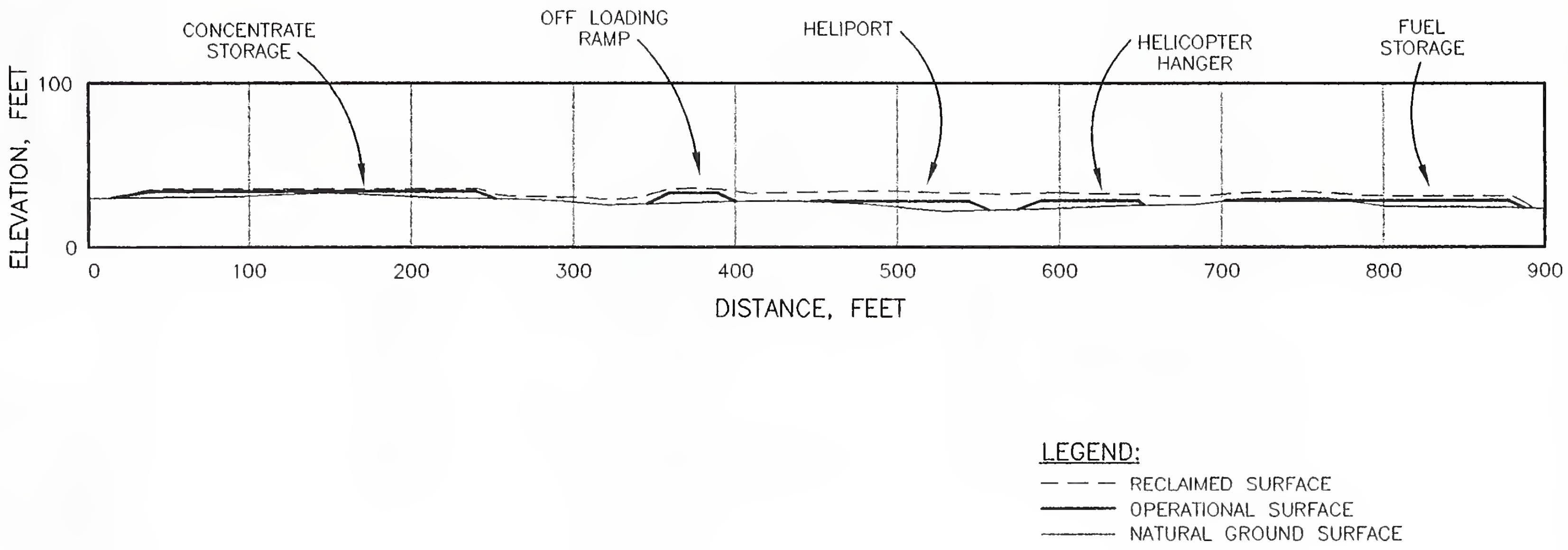
FIGURE 27 OF 40

MARINE TERMINAL
PLAN VIEW



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PROJECT NO.	DATE	REVISION
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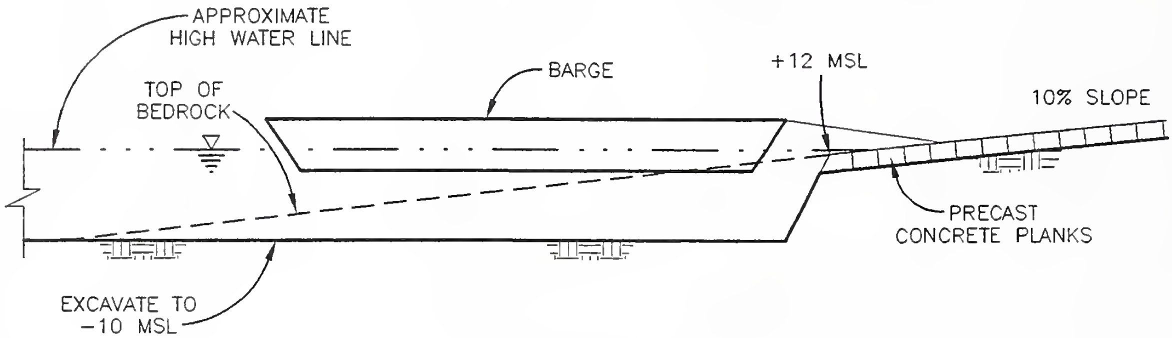
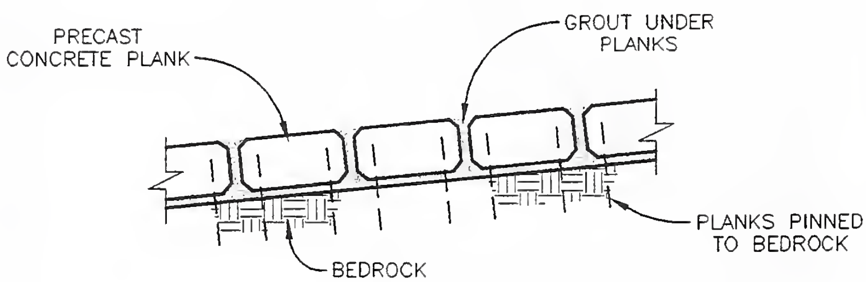
SECTION 1-1
MARINE TERMINAL



SECTION A–A'
(NOT TO SCALE)



SECTION B–B'
(NOT TO SCALE)

OPERATING CONDITIONS:

MAX. BARGE DRAFT=6'
MAX. TUG DRAFT=15'
TIDE OPERATING RANGE=+10' TO +18'

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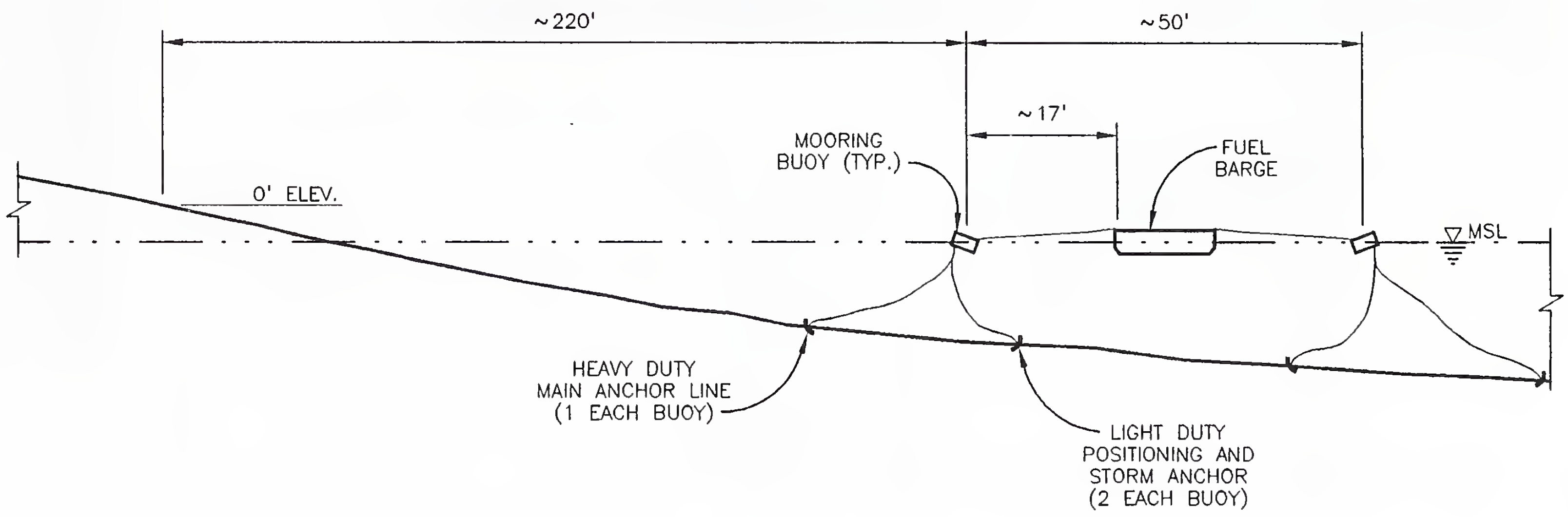
PROJECT NO. 77203	DATE 01/97	REVISION A	LANDING RAMP CROSS SECTIONS

* STA.# I:\0772\77203\404APP\1-97\SHT30.DWG * JAN 10, 1997 * 1:01:53 PM *



SECTION C–C'

(NOT TO SCALE)

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Consulting Engineers & Scientists

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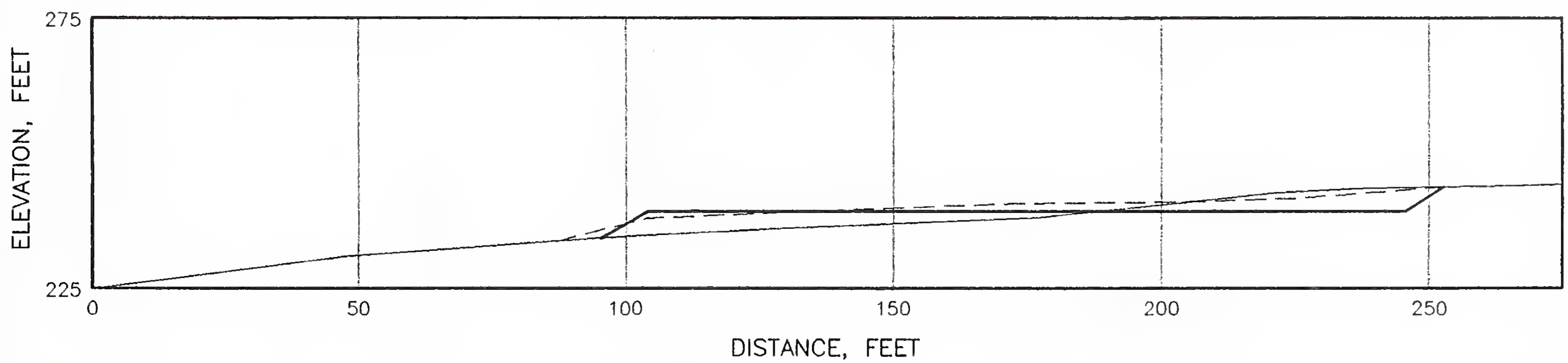
FUEL TRANSFER FACILITY CROSS SECTION

* STA.# :\0772\77203\404APP\1-97\SHT31.DWG * JAN 10, 1997 * 1:02:44 PM *



LEGEND:

- — — RECLAIMED SURFACE
- ——— OPERATIONAL SURFACE
- ——— NATURAL GROUND SURFACE

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Consulting Engineers & Scientists

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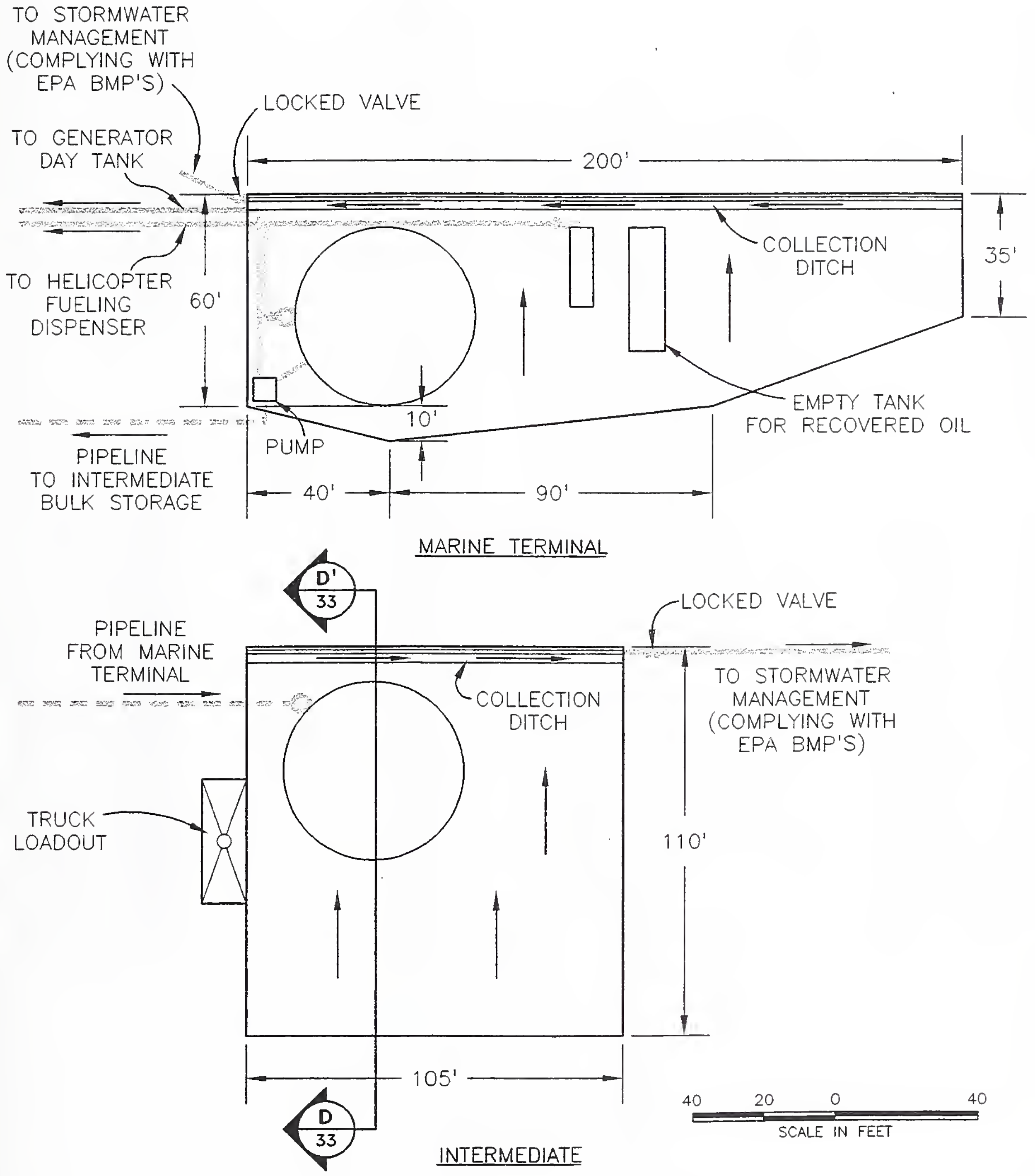
SECTION 6-6
FUEL STORAGE



* STA.#. .:\0772\77203\404APP\1-97\SHT32.DWG * JAN 10, 1997 * 2:52:04 PM *

SRK
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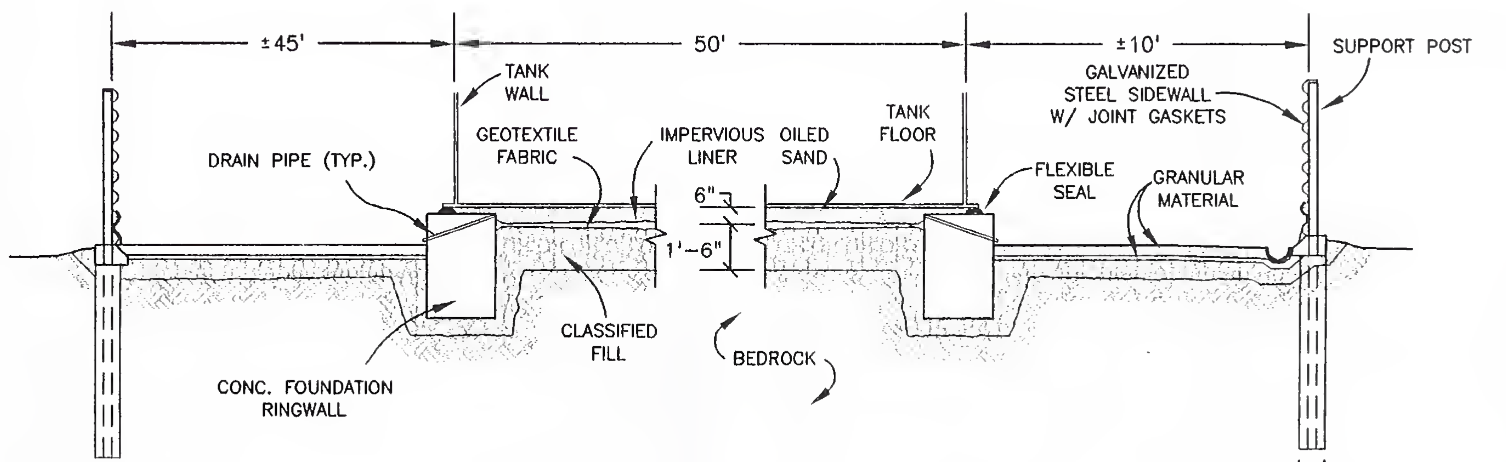
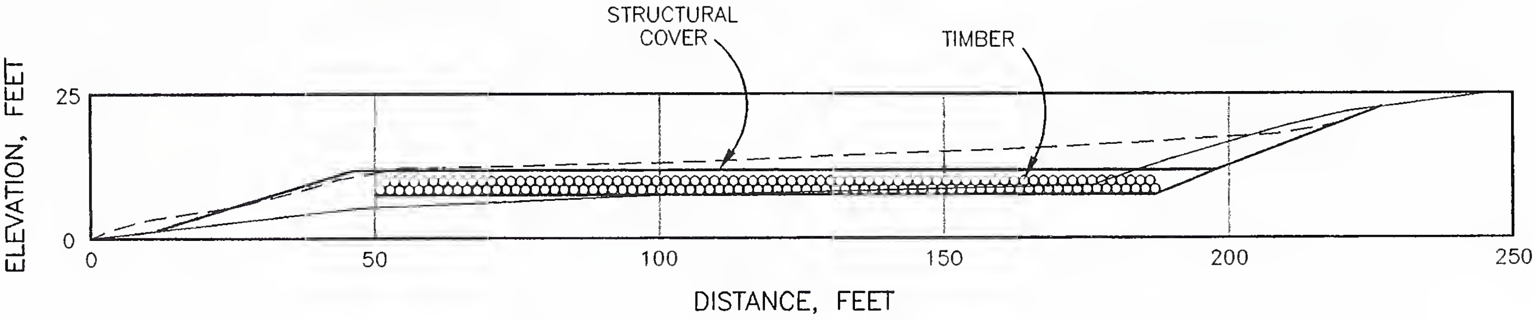
FUEL STORAGE
PLAN VIEW

• STA.; I:\0772\77203\404APP\1-97\SHT33.DWG • JAN 10, 1997 • 1:03:58 PM •



SECTION D-D'

SRK STEFFEN ROBERTSON & KIRSTEN (U.S.) Consulting Engineers & Scientists			**SHEET 33 OF 40** FUEL STORAGE DETAIL SECTION
PROJECT NO. 77203	DATE 01/97	REVISION A	



LEGEND:

- — — — RECLAIMED SURFACE
- ▬▬▬ OPERATIONAL SURFACE
- ——— NATURAL GROUND SURFACE

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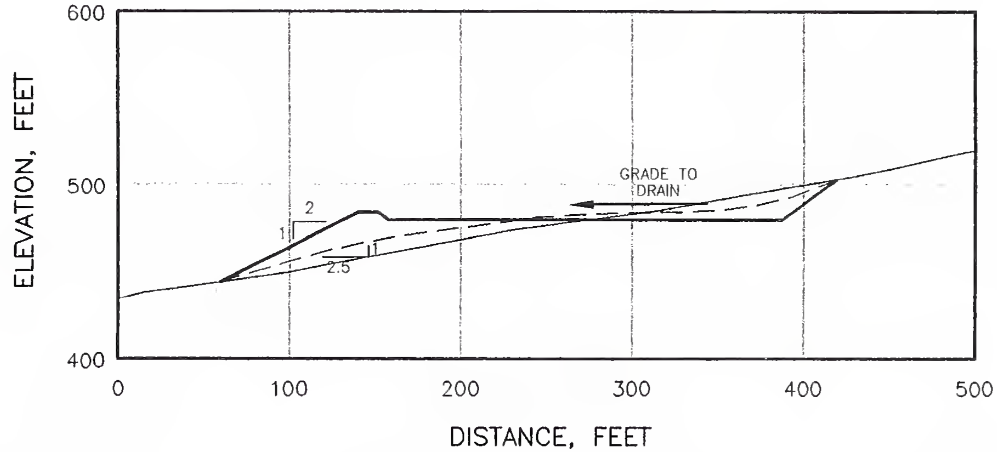
SECTION 7-7
LAYDOWN AREA

* STA.# .\0772\77203\404APP\1-97\SHT35.DWG * JAN 10, 1997 * 2:22:32 PM *



LEGEND:
- — — — RECLAIMED SURFACE
- ——— OPERATIONAL SURFACE
- ——— NATURAL GROUND SURFACE

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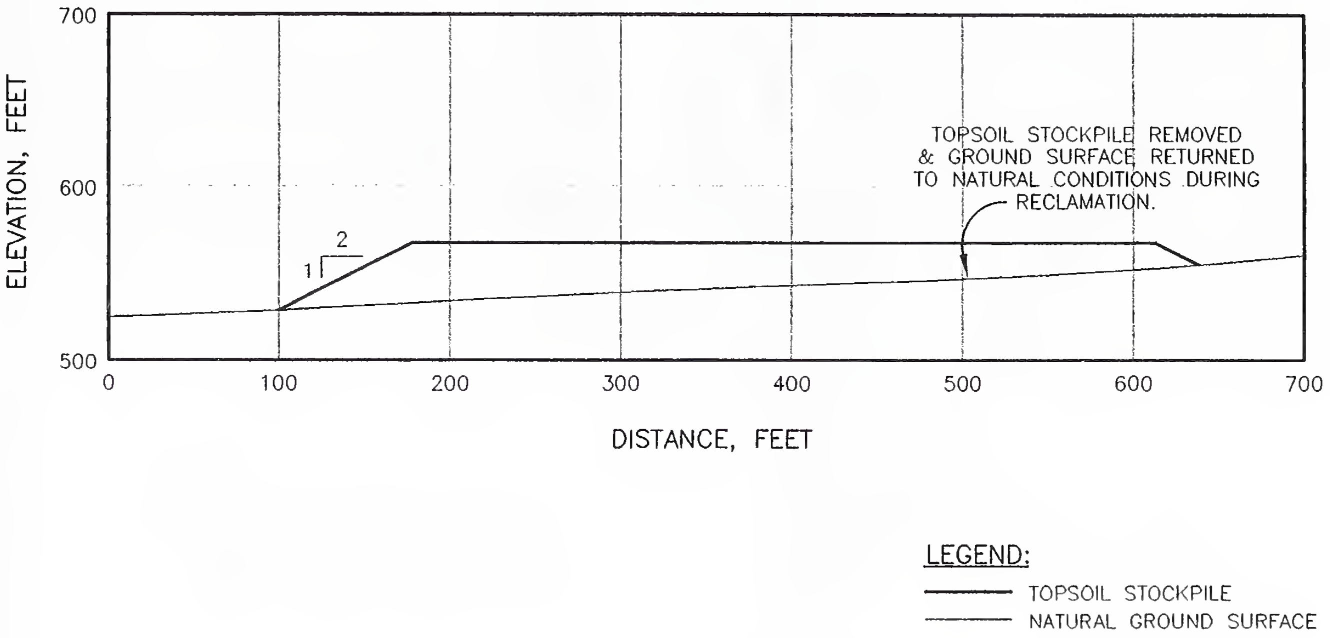
SECTION 2-2
EXPLOSIVES MAGAZINE

* STA.#2 .4:\0772\77203\404APP\1-97\SHT36.DWG * JAN 10, 1997 * 1:09:35 PM *



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Consulting Engineers & Scientists

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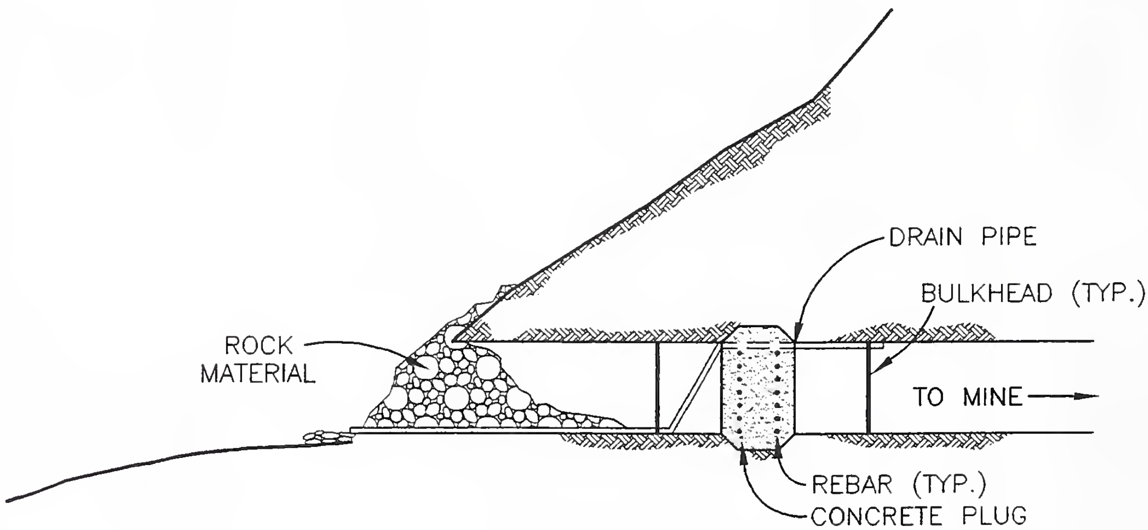
SECTION 15-15
TOPSOIL STOCKPILE



LOCATED IN STABLE AREA DETERMINED BY GEOLOGIC STRUCTURE ANALYSIS

STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
77203	01/97	A

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SECTION 20–20
UPPER PORTALS
PERMANENT CLOSURE

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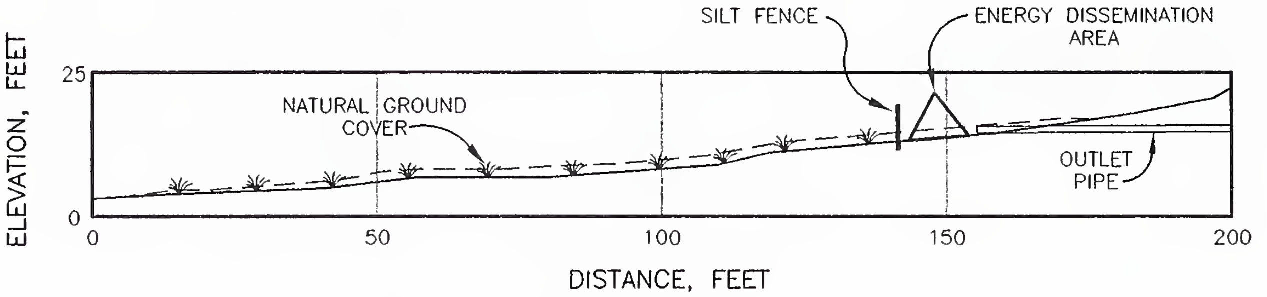

NOTE:

1. SILT FENCE REMOVED DURING RECLAMATION. ENERGY DISSIPATION MATERIAL SPREAD AND COVER IN PLACE DURING RECLAMATION.

LEGEND:

— — — RECLAIMED SURFACE

——— NATURAL GROUND SURFACE

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Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
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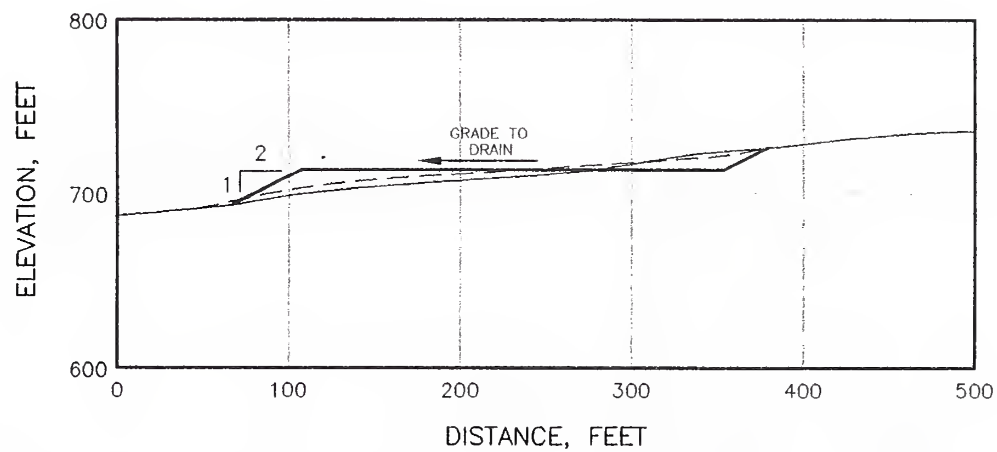
SECTION 13–13 AND 14–14
TYPICAL DISSEMINATION AREA



LEGEND:

- — — — RECLAIMED SURFACE
- ——— OPERATIONAL SURFACE
- ——— NATURAL GROUND SURFACE

STEFFEN ROBERTSON & KIRSTEN (U.S.) Consulting Engineers & Scientists			SHEET 39 OF 40
PROJECT NO. 77203	DATE 01/97	REVISION A	SECTION 18-18 BATCH PLANT

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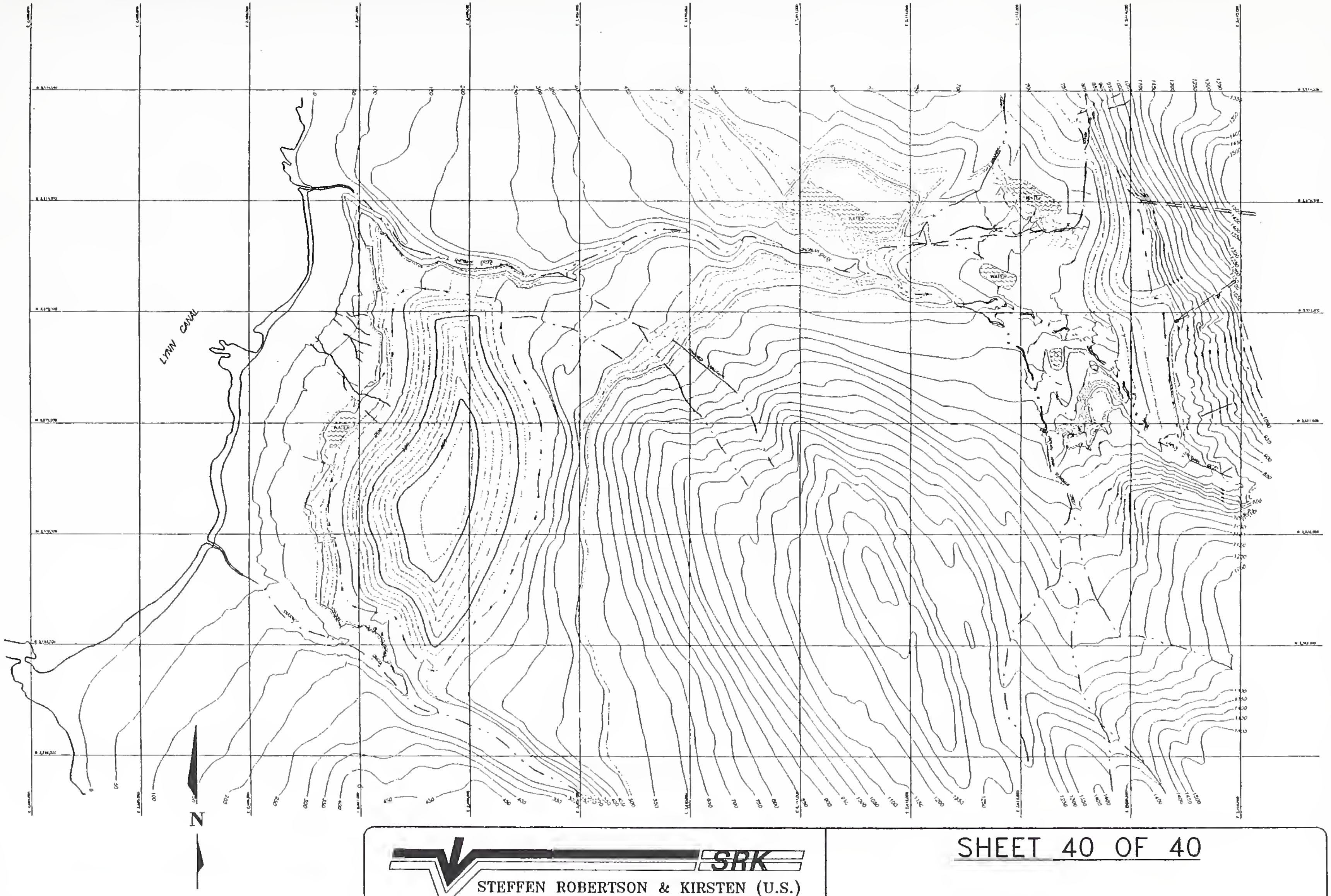

1200 600 0 1200

SCALE IN FEET

SRK

STEFFEN ROBERTSON & KIRSTEN (U.S.)
Consulting Engineers & Scientists

PROJECT NO.	DATE	REVISION
77203	01/97	A

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FINAL RECLAIMED CONTOURS

B. RECLAMATION

This appendix was excerpted from the following document: Steffen Robertson and Kirsten, Incorporated. 1997. *Reclamation Plan, Kensington Gold Project.* Prepared for Coeur Alaska, Inc.

RECLAMATION PLAN

KENSINGTON GOLD PROJECT

Prepared for:
Coeur Alaska, Inc.
431 N. Franklin Street, Suite 400
Juneau, Alaska 99801

Prepared by:
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January 15, 1997
SRK Project No. 77203.0820

3.0 INTERIM RECLAMATION AND DRAINAGE CONTROL

Interim reclamation maintains soils and directs surface water runoff during the construction phase and during any potential temporary mine closure. The major interim reclamation activities are described in this section.

3.1 Construction Phase Reclamation

During construction preparation, vegetation and trees will be cleared in the lands to be developed. Since topography and geologic formation influence the amount of topsoil and organic material available, they will be removed where possible and stockpiled for reclamation activities. The DTF will not have all organic material removed as only the root zone material will be salvaged to facilitate construction. Tables 3.1 and 3.2 summarize the areas and acreage of each parcel along with the quantity of salvaged topsoil. All merchantable timber will be salvaged, removed or used on-site.

3.1.1 Growth Media/Soil Stockpiling

"Growth media" is defined herein as all native soil (in-place) material with physical and chemical properties capable of germinating and sustaining vegetation growth with or without amendments. At the Project site, the term "growth media" is interchangeable with the term "topsoil".

From initial development up to anticipated cessation of mining, approximately 303,000 cubic yards of growth media is estimated to be available for use in reclamation. Table 3.2 gives approximate excavated volumes within stored locations.

Growth media is anticipated to be limited based on measured depths of the A-horizon. The goal will be to combine A-horizon soil and organic constituents to achieve a 1 ft average depth. Application depth will vary between 0-2 ft depending upon the facility and terrain.

Topsoil and overburden stripping will continue as the DTF and ancillary facilities are developed, and suitable growth media and organic material will continue to be stockpiled or directly placed on areas undergoing reclamation throughout the mine life. All organic matter stockpiles will be located and

shaped so that runoff is controlled to limit ingress to the piles. Stockpiles will be protected from wind and water erosion and will be seeded using seed mixes discussed in Section 4.0.

Soil which will be stockpiled for future use during reclamation was evaluated as part of the *Kensington Venture 1992 Reclamation Plan* ("wet" tailings option) for suitability and are shown in Appendix B.

3.1.2 Interim Monitoring

Once physical reclamation has started, temporary diversions and sedimentation control systems will be monitored on a routine basis by Coeur personnel. These systems will be cleaned, repaired, and altered as necessary. Long-term or permanent diversions and berms will be monitored and maintained as needed until the reclamation surety has been released. Interim reclamation visual monitoring will also include photographic records.

3.2 Concurrent Reclamation During Mine Operation

Reclamation concurrent with mining operations refers to phased reclamation of the borrow areas and DTF. Concurrent practices are similar to final reclamation procedures (Section 4.0) and include fill placement and grading, growth media placement/grading, scarification, seeding, mulching, and fertilizing.

The borrow areas will be reclaimed concurrently as gravel and till sources are spent. Portions of the borrow area and any other ancillary regrading will begin within one year of completed use, and revegetated within 60 days of regrading. Regraded material will be placed over the active area followed by placement of growth media. The area will then be scarified to roughen the texture of the surface, lessening erosional impacts by creating resistance to water and increase soil infiltration rates (Law, 1984). Roughened soil will create micro-areas for seed and moisture stabilization.

Areas intended as open water post-mining land use will not use topsoil as part of the reclamation activities. Topsoil will be placed on fringe areas.

The DTF facility cells will undergo reclamation as soon as practical during operations and includes reclaiming the surface of the facility, as well as construction of diversions, rock covers, and other ancillary features.

DTF cell reclamation will include interlift development along with fill placement/grading, growth media placement/grading, scarification, seeding and mulching/fertilizing as needed. In the event the mine is closed prior to completing the DTF, the interior-slope face between phases and the remaining upper lift active area will be covered with up to 5 ft of coarse till prior to the growth media layer.

Vegetative cover for concurrent and final reclamation is site specific and requires site investigation. There are two vegetation sites: the saturated wetlands and non-saturated uplands. Coeur will evaluate the vegetative success on DTF concurrent reclamation to gather information on the regenerating potential of native species in upland areas. Currently, the seed mix for upland and wetland regeneration includes grasses and forbs that can be broadcast spread (Table 3.3). If during the course of concurrent reclamation it is determined that a modification is required, the seed mixture, application or other appropriate techniques will be evaluated and initiated as required to meet reclamation goals and objectives. Concurrent reclamation revegetation will be recorded with photographs and test descriptions.

Mulch can also reduce wind and water erosion, and may include twig wood chips, sawdust, shredded bark, and gravel. Mulching and fertilization requirements will depend on concurrent revegetation results and may include hydromulching or other appropriate method of placing a mulch material. Mulch material used at the site will minimize potential foreign seed introduction to the project. Optimum techniques for achieving revegetation in final reclamation will be derived from concurrent reclamation.

3.3 Temporary Mine Shut-down Reclamation

Temporary mine shut-down refers to mine and process operations being postponed for a period of not more than three years. This is not to be confused with seasonal mining closures which may periodically occur due to extreme weather conditions. If conditions require temporary closure to extend beyond three years, final reclamation will begin, unless an extension is requested by Coeur and approved by the appropriate regulatory agencies. Temporary closure scenarios which require

modifications to the plan of operation or the reclamation plan will be coordinated with and submitted to the appropriate regulatory agencies for approval.

Seven conceivable closure scenarios have been identified for which costs have been estimated (Section 6.0): closure after initial construction of all facilities but the DTF or closure after completion of each of six DTF cells/phases. Concurrent DTF cell reclamation is possible due to the tailings consistency and landform, enabling closure and reclamation at any time during operations, unlike wet tailings.

Temporary closure may include planned or unplanned cessation of mining and processing operations. During temporary closure, all environmental programs will be maintained according to agreed upon schedules. Interim vegetation, water management, and erosion control measures will be implemented to protect onsite water quality, and interim reclamation activities will continue as planned.

3.4 Best Management Practices

BMPs used for drainage stabilization and erosion control during construction, interim reclamation and final reclamation are discussed in the *Surface Water Management Plan Report* (SRK, 1994b) and *Kensington Gold Project Report on Construction Activity Related to Creek Crossings and Alterations* (SRK, 1996f). BMPs will be used to minimize sediment transport from disturbed areas prior to the construction of more permanent facilities such as sediment ponds. BMPs will also be used in areas that are down gradient from the ponds (i.e., haul roads) to minimize sediment transport. During reclamation, most facilities will require BMPs for drainage stabilization and erosion control.

Examples of BMP erosion control include diversion of runoff, minimizing the size of disturbed areas, limiting the time of exposure, sediment control devices, and establishing permanent vegetative cover. The goal is to prevent erosion where possible and to retain most of the sediment on site where erosion cannot be prevented. The USFS provides guidance for use and installation of BMPs, and these guidelines will be followed as part of the reclamation plan.

4.0 SITE-SPECIFIC RECLAMATION PLAN

This section presents a discussion of reclamation techniques planned after process facility shutdown and decommissioning, followed by site-specific considerations for the DTF and wetlands.

4.1 Facility Shutdown and Decommissioning Activities

Facility shutdown and decommissioning includes removing all operations from service that are not needed to complete reclamation and post-reclamation. These activities are operational and are accomplished prior to reclamation.

The chemical and petroleum storage facilities, process plant buildings, laboratory facilities, office and maintenance shops will be removed from service. Decommissioning activities will include pumping remaining products and neutralizing reagents or chemicals in pipes, tanks, and other items. Tanks will then be cleaned and purged.

Rinsed solutions will be collected and treated according to applicable rules and regulations. All controlled and hazardous chemicals, fuels and regulated materials will be removed from the site for recycling or disposed of in an approved manner.

4.2 Reclamation Process

The reclamation process requires several tasks designed to fulfill the reclamation objectives (Section 1.4): 1) demolition; 2) portal closure; 3) channel stabilization; 4) fill placement and grading; 5) excavations; 6) ripping; 7) growth media placement; 8) growth media grading; 9) scarification; 10) seeding, mulching, and fertilizing; and 11) monitoring. The Project operations will, to some degree, alter the landscape and topography of the site (Drawings RP-7 and RP-8, Figures 4-1 through 4-25). Coeur will reclaim the site to the extent necessary to provide wildlife habitat use and minimize visual impacts.

The topographic characteristics of the DTF will resemble a vegetated hill (Drawing RP-7, Figures 4-8 and 4-9). The process area will be regraded to resemble the surrounding topography, but some of the cut will remain (Drawing RP-8). The sand and gravel borrow area, till borrow area, and mine water

ponds/sedimentation pond will resemble the surrounding topography but modified to include open water and wetlands based on contouring, hydrology, and wetland species invasion (Figure 4-1, 4-2, 4-10, 4-13, 4-14, 4-15, 4-16). All other areas with the exception of the DTF, process area and marine terminal will be reclaimed as wetlands. Earthwork will utilize industry standard heavy equipment.

Temporary sediment control devices (BMPs) that are part of the reclamation activities will be removed when the site specific potential of erosion has been minimized through earthwork and revegetation activities. Long-term or permanent diversions associated with the DTF will be monitored and maintained as needed until the reclamation surety has been released.

The main drainage and DTF sediment ponds will be maintained through reclamation until revegetation has been sufficiently established to limit sediment generation from reclaimed areas. At that time, the ponds will be regraded to establish open water and wetlands. In the event that liners are used, liners above the sediment level will be cut or folded over, and buried in-place. Holes will be poked through the liner if required. Additional cover will be placed over the liner.

Once physical reclamation has started, temporary diversions and sedimentation control systems will be monitored by Coeur personnel as with interim reclamation. These systems will be cleaned, repaired, and altered as necessary.

Drawings RP-7 and RP-8 and Figures 4-1 through 4-25 illustrate post-reclamation topography, while Drawing RP-9 summarizes reclamation tasks by area. The following sections describe each reclamation task.

4.2.1 Demolition

Demolition includes removing all equipment, buildings, above ground power and telephone lines, removing or burying concrete foundations and footers, and removing piping to just below grade. All structures will be removed unless otherwise decided in cooperation with the USFS, State of Alaska and CBJ.

Concrete slabs to be demolished include those at the marine facility which include the hanger, concentrate storage, generator building, aviation fuel tank, off-loading ramp, and heliport pad and

those at and near the process area which include the mill office, maintenance building, tailings filter plant, mine drainage water treatment and other ancillary facilities. Concrete slabs less than 1 ft thick will be broken up with a dozer and buried in place with the exception of the off-loading ramp which will be broken up and buried with other foundations at the beach facility. Foundations other than the ramp will be broken and/or buried during grading (Section 4.2.4). Foundations thicker than 1 ft in the process area will be buried. Footings for facilities including the sediment ponds, domestic wastewater treatment systems, personnel buildings and bridges will be buried as fill material.

Buildings will be taken down and salvaged and building timbers, footers, or foundations buried in place. The explosives storage building which is made of 1-inch steel and lined with plywood, will be cut up and salvaged. All above ground steel tanks will be removed for salvage. Three underground concrete tanks serving the domestic wastewater treatment systems will be left in place underground.

All aboveground piping for these and other facilities will be removed to just below grade and ends will be capped. When electrical power requirements are no longer necessary, generators and associated facilities will be removed from the site for salvage. All above grade lines will be removed, while underground conduit below grade will remain in place.

The bridge and culverts are not necessary when the haul road is removed at post-closure and will be removed or buried. The bridge will be removed and salvaged, while culverts will be buried in place if the drainage configuration allows for minimal erosion. Where drainages are susceptible to erosion, culverts will be removed and disposed of according to the Solid Waste Permit.

All fencing around the process, shop, reagent and explosives storage areas will be removed.

All salvageable equipment, instruments, furniture, buildings, and other material will be removed from the site. Inert construction and demolition debris will be placed in appropriate on-site disposal areas previously approved, buried during grading or removed from the site. This includes foundations, concrete slabs, culverts and other similar items.

4.2.2 Portal Closure

At the completion of mining, the upper portals and ventilation raises from the underground workings will be permanently stabilized and sealed with concrete (Figure 4-25).

Development rock left at the mine adit will be either removed and placed in the DTF as part of its final closure, used in mine adit closure or regraded and reclaimed in place.

4.2.3 Channel Stabilization

Channel stabilization includes returning Ophir Creek to the original location and configuration, removing conduit at road crossings (Drawing RP-3), stabilizing natural intermittent drainages along the road, and stabilizing the Process Area bench diversion (SRK, 1996f). Major factors to be manipulated during waterway reclamation include rainfall and surface water energy, soil type, slope length and gradient, cover, and BMPs. These factors will be evaluated and planned in detail prior to mine closure. BMPs for channel stabilization are discussed in *Kensington Gold Project Report on Construction Activity related to Creek Crossings and Alterations* (SRK, 1996f).

Riprap material for channel stabilization and conduit crossing removal will be obtained by screening on-site materials obtained from blasted rock excavations at the bench and/or gravel derived from the Marine Facilities. No mine waste or significant materials will be placed in the wetlands or waters of the U.S. outside the approved Project footprint. The approximate quantity of material required was estimated at 8,693 cy.

Ophir Creek

The Ophir Creek Diversion will be returned to its natural drainage course at the close of mining and milling activities. The diversion will be regraded to match the natural topography and promote run-off to the original drainage course. Portions of the diversions which meet Ophir/Ivanhoe Creeks will be regraded and riprap placed to promote long-term stability. Riprap will be sized according to the flow data.

Conduit Crossings

Three long-span low-profile arch conduits will be used to route creek flows during Project development (Drawing RP-3). These conduits will be removed at road crossings during reclamation: one over Ivanhoe Creek and two on Sherman creek. The area will be contoured with the surrounding topography to blend with natural shapes. These channel segments will also be stabilized with an average of approximately 18 inches of riprap, with considerations for surface water, soil, slope, cover, and BMPs.

Haul Road Drainage Courses

Six drainage courses in the Sherman Creek drainage basin will be reclaimed where they intersect the haul road (Drawing RP-3). They will be contoured to resemble pre-disturbance conditions and stabilized with 9 inches of riprap.

Main Process Area Bench and DTF Diversions

The main diversion on the east side of the Process Area bench and the DTF main stormwater diversion will be enlarged to accommodate larger scale storm events following reclamation. Again, the modified Process Area bench diversion will be contoured as closely as possible to blend with surrounding topography with an average riprap depth of 18 inches for stabilization. The DTF main stormwater diversion will be lined with approximately 9 inches of riprap in areas not already stabilized.

4.2.4 Fill Placement and Grading

All disturbed areas will be regraded, including the marine facilities, intermediate fuel storage, explosives storage, batch plant, personnel camp, sand and gravel borrow areas, process area sediment pond, DTF sediment pond, till borrow area, Ophir Creek stormwater diversion, haul roads, culverts, stormwater diversions, topsoil stockpiles, DTF coarse till cover, and DTF haul road. Fill placement and grading for similar facilities will be discussed together, while unique facility situations are discussed separately. See Drawings RP-7 and RP-8 for post-reclamation topography. Post-reclamation contour cross-sections are detailed in Figures 4-1 through 4-25.

Haul Roads

All roads will be reclaimed, but the schedule is dependant on monitoring requirements, which will be evaluated near mine closure. Roads not required for long-term monitoring site access will be reclaimed with the other facilities.

With the exception of bedrock outcrops, the haul road fill slopes will ultimately be contoured to blend in with the surrounding terrain (Figures 4-5, 4-6 and 4-7). As discussed in Section 4.2.3, stream crossings and surface water drainage will be reclaimed to their approximate original conditions. The main access haul road and borrow area haul road will be regraded by bulldozing or back dragging the down slope fill area back into the slope cut. The process area haul road from the main access haul road to the north slope will be regraded by flattening the fill slopes from an average of 2H:1V to an average of 2.5H:1V.

Process Area and Development Rock Disposal Bench

The bench cut and fill slopes and surface area will be regraded to control surface water runoff and to blend with the surrounding topography as much as possible (Figures 4-21 and 4-22). Fill material over the bench will average 3 ft, covering process concrete slabs.

Marine Terminal, Laydown Area, Fuel Storage, Explosives Magazine, Batch Plant, and Personnel Camp

Concrete slabs, other than the loading ramp, will be broken up with the bulldozer. Concrete pieces and footings will be buried in fill material. Cut and fill will be contoured to blend with the surrounding topography with a fill quantity equivalent to approximately 1 ft (Figures 4-3, 4-4, 4-11, 4-12, 4-20 and 4-23).

Sand and Gravel Borrow and Till Borrow Area

The borrow areas will be graded in benches with a typical configuration illustrated in Figures 4-13 through 4-18. These areas will be contoured to include open water with a saturated perimeter developing into wetlands.

Process Area Sediment Pond and DTF Sediment Pond

Both sediment ponds will be regraded to create open water areas which blend with surrounding topography (Figures 4-10 and 4-24). The remaining pond cut and embankment fill slopes will be

graded to blend with the surrounding topography providing wetlands around the pond perimeter. Footings will be buried in fill material. No mine waste or other materials will be placed outside the disturbance footprint.

Ophir Creek and Other Stormwater Diversions
The Ophir Creek Diversion will be regraded to blend with the surrounding topography (Section 4.2.3). During construction, excavated common earth will be placed adjacent to the diversion and bulldozed back in place during reclamation grading. Similarly, material excavated during construction of other diversions will be placed adjacent to the diversions or used as embankment fill. The material or fill will be back-filled during grading to resemble surrounding topography.

Haul Road Culverts
Culverts along the haul road will be buried in-place unless the culvert routes runoff from a natural drainage course. Six access road culvert excavations will require backfilling to blend with the surrounding topography (Drawing RP-3). Excavated material will be regraded to match the surrounding topography which allows surface run-off to remain in a stable stream channel.

Topsoil Stockpiles
The topsoil stockpile(s) will be regraded after growth media is dispersed over the disturbed areas (Figure 4-19). Most growth media will be stored at the process topsoil stockpile. However, the growth media stripped at the haul road will be stored at the toe of the road fill slope, and stabilized during the mine life (Section 3.1.1). In addition, temporary topsoil stockpiles will be used at the DTF until concurrent reclamation activities are ready for placement of growth media. Temporary stockpiles will be used in the borrow sources as well.

DTF Coarse Till Cover and Haul Road
If temporary mine shut-down occurs during DTF construction, the interior slope face (between a completed cell and a proposed cell) and the active area of the upper lift will be covered with an additional 5 ft of coarse till (Drawing RP-6).

The DTF haul road will be regraded to blend with the surrounding topography. The down-slope fill area will be bulldozed back into the upslope cut area.

4.2.5 Excavations

Facility excavating includes culverts, conduits, infiltration gallery pipe removal, bench diversions and DTF main stormwater diversion modification. Six haul road culverts will be removed along with three long-span conduits (Drawing RP-3). Infiltration gallery piping will be removed from the Upper Sherman Creek stream bed to a minimum distance of 10 ft outside the stream banks.

4.2.6 Ripping

Ripping will loosen and break-up compaction caused by operation of heavy equipment. Surface manipulation such as ripping is also needed in areas that are likely to develop rills and gullies. Areas requiring ripping include haul roads, the process area and development rock disposal bench, marine facilities, intermediate fuel storage, explosive storage, batch plant, and personnel camp.

Areas of compacted fill surfaces will be ripped with a bulldozer to an approximate depth of 1 ft prior to topsoil placement.

Borrow areas will be regraded and ripped where required to meet post-closure reclamation goals. Approximately 20 percent of the process bench surface area will have concrete slabs buried in-place, while the remaining surface area will be ripped.

4.2.7 Growth Media Placement and Grading

Topsoil and mulch piles will be used for the growth media source. An average of one foot of growth media (0-2 ft variance) will be placed over all disturbed areas excluding slope cuts, riprap or other areas designated in the plan.

4.2.8 Growth Media Scarification

The process of spreading growth media will often create compaction, which is relieved by scarification. A roughened configuration will serve to trap moisture, reduce wind shear, minimize surface erosion by increasing infiltration, and create micro-habitats conducive to seed germination and revegetation.

4.2.9 Seeding, Mulching and Fertilizing

The focus of initial revegetation is on establishing grasses for stabilization that allow for successional plant communities of forbs, alder, and muskeg/spruce. Table 3.3 describes two recommended grass seed mixes proposed for drier upland areas or wetlands. As mentioned in section 3.2, Coeur will evaluate vegetative success during interim reclamation. Dry upland areas include the DTF, marine facility and process area, while the remaining area soils will normally be saturated, resulting in wetlands.

Revegetation will be implemented using hydroseeding which combines seed, mulch, and fertilizer. Generally, seeding is to be implemented from spring until mid-July, but during a period with minimum standing water to maximize germination.

A hydroseeder broadcasting technique combines seeds, water, mulch, fertilizer, and tackifier to provide a favorably moist and protected germinating environment. Hydroseeders are successful in areas like Kensington mine where there is adequate moisture to continue providing moisture for seeds for two to three weeks until the roots are established on the seedlings (Law, 1984).

In this ecosystem, it is desirable to use mulch produced from native tree and shrub twigs in order to encourage an organic mix that decomposes readily into the soil providing nitrogen fixers and nutrients (USFS, 1996). Due to limited quantities of natural mulch, it may be necessary to add another source of wood fiber mulch. If needed for additional protection, straw or grass hay will be used, depending upon availability. If some areas of terrain are too rough for hydroseeding equipment, handseeders will be used to spread seed. Mulch and fertilizer will be spread by hand in these areas.

The recommended rate of application for seed mixtures, fertilizer and mulch is summarized in Table 3.3 (USFS, 1996).

4.3 Closure Criteria

The Project will be considered successfully reclaimed when all activities identified in the plan have been completed. This will include facility shutdown and reclamation tasks such as building removal,

portal plugging, regrading and revegetation where applicable. Revegetation criteria will be used to determine revegetation success.

After three years, at least 30 percent live cover will be established to meet reclamation objectives and bond release. Less than 30 percent live cover on revegetated sites will require that additional action must be taken. Coeur will evaluate the site for potential causes of vegetation failures. The appropriate remedies will be implemented and the site reseeded. This could include scarification, fertilization and seed modification, or similar actions.

If, three years after the second seeding, the site does not meet the 30 percent live cover criteria, it will be assessed for large rills and gullies. If no large rills and gullies are present, the site condition will be deemed appropriate for release. If large rills or gullies are present, Coeur will undertake appropriate regrading activities to correct the rills and gullies. After one season, if the rills and gullies do not return, the site can be released from reclamation bond.

4.4 Specific Considerations

4.4.1 DTF Facility

Concurrent reclamation of the DTF will occur throughout its operational life, and entails physical stabilization of the tailings. With the placement of the tailings, capping and reclamation cover, the configuration of the facility has been designed to promote runoff and allow surface water control (Drawing RP-7). Each lift of tailings results in a bench on the external slope of the facility and creates a lateral drainage path for runoff. Surface water diversions surrounding the DTF will be left in place at closure and reclamation. The ditch to the east of the DTF will be designed to provide long-term maintenance-free control of run-on to the facility, and at closure, the capacity will be increased to accommodate flows in excess of the 500 yr/24 hr storm event.

At closure, drainage from the DTF will diminish and, following reclamation of the surface of the facility, runoff would be similar to pre-development conditions. This will allow sediment pond decommissioning and removal. Sediment pond demolition and reclamation will follow DTF reclamation.

4.4.2 Wetlands

The sediment ponds, sand and gravel borrow, and till borrow areas will be contoured in preparation for pond and perimeter wetland establishment (Drawing RP-8). Regrading activities will provide areas of open water and/or saturated soils over most of the year. All other areas with the exception of the DTF, process area and marine terminal will be reclaimed as wetlands. In addition, the DTF diversions will provide open water and fringe wetland areas. The haul roads, personnel camp, fuel storage and laydown areas, explosives storage area, topsoil stockpile, dissemination area and batch plant will be reclaimed as wetlands habitat areas similar to pre-mining conditions. To begin revegetation, the seed mix will be comprised of the species listed in Table 3.3. Increased areas of open water in combination with natural succession will provide for a more complex ecosystem of native forbs and shrubs for increased diversity.

C. SOIL AND WATER CONSERVATION HANDBOOK

This appendix was excerpted from the following document: U.S. Forest Service. 1996. *Soil and Water Conservation Handbook.* Juneau, Alaska. FSH 2509.22, Amendment No. 2509.22-96-1.

17 - MINERALS MANAGEMENT. Minerals (including oil, gas, and geothermal resources) exploration and development activities on National Forest System lands fall into 3 categories:

Locatable, Leasable, and Saleable.

1. Locatable. The General Mining Law of 1872, as amended, governs the prospecting for and the appropriation of metallic and most non-metallic minerals with a distinct and special value on National Forest System lands that were reserved from the public domain. This applies to most hard rock and placer mineral deposits.

Instruments that analyze and approve locatable mining activities which could affect water quality on National Forest System lands are Notice of Intent to Operate, Plan of Operations, Environmental Analysis, Special-Use Permit(s), Road-Use Permits and State and/or other Federal agency permits and certification (36 CFR 228, Subpart A and FSM 2810).

A Notice of Intent to Operate is required to conduct mining-related activities which may cause disturbance of surface resources on National Forest System lands. The proposed operations described in the Notice must be evaluated and the operator informed that either the operation is exempt from the requirement for a Plan of Operations, or that one is required. If it is determined that significant disturbance of surface resources will likely result from the proposed operations, the operator must submit a Plan of Operations to the District Ranger.

A written Plan of Operations is required from all operators who will likely cause a significant disturbance of surface resources. Prior to approval of the plan, the operator may be required to furnish a bond in the form of a surety or other security to perform reclamation work. All hazardous materials to be used should be listed in the Plan of Operations which shall be submitted to the Forest Service for review and analysis.

A Plan of Operations is also required for construction or reconstruction of roads for access to mining claims if the cross National Forest System lands. Plans of Operation may include supplementary plans for water quality monitoring and erosion control. All Plans of Operation must include how operations are to be conducted to minimize adverse environmental impacts, including compliance with State and Federal Standards.

Special-use permits may also be required and issued for water diversions, water transmission facilities, and electric transmission lines outside of mining claims but needed for mining activities. Permits are required for commercial use of National Forest System roads.

State and other Federal agency permits and/or certification may be required and issued for air quality, water quality, tidelands development, reclamation, disposal and treatment of solid wastes, and so forth. When required, the Forest Service will advise the operator to obtain the appropriate permits or certification. If the proposed operation will involve the use or generation

of hazardous substances, the operator is required to incorporate the permitting requirements of the appropriate regulatory agencies (36 CFR Subpart A 228.8).

2. Leasable. The Mineral Leasing Act of February 25, 1920, as amended and supplemented, subjects certain mineral and energy resources to disposal through leasing actions.

These energy and mineral resources include, but are not limited to, coal, oil, gas, geothermal, oil shale, potassium, sodium, and phosphate. The Mineral Leasing Act for Acquired Lands of August 7, 1947, makes all minerals on acquired (purchased) National Forest System lands, unless otherwise reserved or held as outstanding rights, subject to the provisions of the 1920 Minerals Leasing Act.

The Forest Service and Bureau of Land Management (BLM) make a determination, through the NEPA process, as to whether or not a permit, license, or lease should be issued by the BLM. The Forest Service and BLM develop the stipulations needed to protect water quality and other resource values. Provisions for special-use permits, and State and/or Federal Agency Permits or Certification also apply (36 CFR 228, Subpart E and FSM 2820).

Mitigation measures are developed by an interdisciplinary team during the environmental analysis and are written into the special stipulations section of the permit, license, or lease. Conditions of approval are also developed by the interdisciplinary team to be included in the operating plan.

By interdepartmental agreement, all applications to lease lands under Forest Service jurisdiction are referred to the Forest Service for review, recommendation, and development of special stipulations to protect the surface resources. Administration of oil and gas surface operations on National Forest System land is the responsibility of the Forest Service, but BLM administers the lease.

3. Saleable (Common Variety) Minerals. The Materials Act of July 31, 1947, provides for the disposal and use of common variety mineral materials such as sand, stone, gravel, pumice, cinders, and clay located on National Forest System lands. Disposal can be by sale or free-use permit to private entities or Federal, State, and local units of government, when consistent with good public land management and in the public interest (Refer to 36 CFR 228, Subpart C and FSM 2850).

Common variety mineral materials may be disposed of and developed when their use is consistent with good public land management and in the public interest. Use authorizations will require reasonable erosion control and rehabilitation and revegetation of the surface. Removal may be approved if adequate measures can be accomplished to prevent erosion or stream pollution, and satisfactory arrangements can be made for rehabilitation and restoration as outlined here. New road construction, if allowed, will be located, constructed, and maintained to protect the soil and water.

A project plan or Mineral Material Permit identifies the location and conditions of mineral material removal and disposal. Both will be preceded by an environmental analysis. Project

location, the scope of the proposal, and detailed mitigative measures are developed using an interdisciplinary approach. Compliance with the project design standards, the terms and conditions of the permit, and applicable Federal and State regulations is assured by the Forest Service. Mineral extraction sites can be evaluated for possible post-operation utilization as fish habitat.

All developed mineral material sites will have a site plan developed for the construction and operation of the site. The site plan will include a 1-inch to 400-foot scale map showing the limits of the development, location of structures, top soil stock piles, hazardous areas, and contours and excavated configuration of site.

Operation plans should include the period of operation, equipment and methods of operation, safety requirements (State and Federal), environmental compliance (requirements, monitoring and standards), and a reclamation plan showing final closure envisioned.

17.1 – PRACTICE. Mining Site Conditions, Planning, and Design.

OBJECTIVE. To incorporate soil and water resource considerations into the Plan of Operations for exploration and extraction of locatable and saleable minerals.

EXPLANATION. This is an administrative and preventive practice. The exploration and extraction of locatable and saleable minerals must follow an approved Plan of Operations. This plan should address soils and water resource concerns in the design and operation of the project. It should include descriptions, maps, and sketches of the proposed mine site and onsite riparian areas. Overall plans and schedules for sequential site operations, surface and groundwater monitoring, and site rehabilitation should be presented for the duration of planned mining at the site.

Section 505(a) of ANILCA (PL 96-487) gives special direction for mining in Alaska:

"The Secretary of Agriculture shall...maintain the habitats to the maximum extent feasible, of anadromous fish and other foodfish, and to maintain the present and continued productivity of such habitat, when such habitats are affected by mining activities on National Forest lands in Alaska."

Related BMPs for soil and water protection have been identified here to cover the full scope of planning for mining operations. The following categories, where applicable, should be described in narrative form and/or sketch in the mining Plan of Operation:

1. Existing Site Conditions:

    a. Physical site characteristics:

– Legal claim location description – Map of streams, diversions, natural ponds, water treatment ponds, tailings, waste rock, and ore piles within and immediately adjacent to the mining claim

- Floodplain Analysis and Evaluation (BMP 12.4)
- Wetlands Analysis and Evaluation (BMP 12.5)
- Riparian Area Designation and Protection (BMP 12.6 and 12.6.1)
- Protection of Potentially Unstable Areas (BMP 14.7)

b. Biological characteristics:

- Amount and type of vegetation
- Presence of fish
- Value of stream aquatic habitat for risk evaluation

c. Stream characteristics:

- Scale map of existing stream pattern
- Water quality
- Timing, magnitude and duration of flood events
- Drainage pattern for overland flow during intense rainfall events

2. Location, Design, Construction, and Operations:

a. Exploratory drill holes:

- Scale map and descriptions of the proposed drill sites, drill hole depths, and use of any drilling compounds

b. Operations camp:

- Scale map and description of the proposed mining camp
- Sanitary facilities/temporary camps (BMP 12. 15)
- Control of solid waste disposal (BMP 12.16)

c. Processing facilities:

- Proposed method of milling or materials handling
- Chemicals (including, where applicable, Material Data Safety Sheets) and chemical processes to be used in milling

- Runoff collection, runoff dispersion, sediment collection, soil stabilization, seeding, and revegetation

d. Access routes:

- Location of transportation facilities (BMP 14.2)
- Design of transportation facilities (BMP 14.3)
- Measures to minimize mass failure (BMP 14.7)
- Measures to minimize surface erosion (BMP 14.8)
- Drainage control to minimize erosion & sediment (BMP 14.9)
- Bridge and culvert design and installation (BMP 14.17)
- Development and rehabilitation of gravel sources & quarries (BMP 14.18)

e. Control, treatment, and disposal of mine drainage and/or mill effluent:

- Slurry and wastewater pipelines
- Water treatment ponds and other facilities

f. Water withdrawal:

- Diversion ditches and headgates
- Water impoundments

g. Waste rock and tailings disposal areas:

- Mineralogic chemical characteristics of waste rock tailings
- Potential for production of metal leachates, acid rock drainage, and sediment
- Runoff collection, runoff dispersion, sediment collection, soil stabilization, seeding, and revegetation

h. Storage and handling of fuel and other toxic material:

- Oil Pollution Prevention & Refueling Operations (BMP 12.8)
- Oil and Hazardous Substance Pollution Planning (BMP 12.9)

i. Clearing and stockpiling of overburden:

- Type of material

- Method and timing for clearing
- Storage location for materials
- Erosion control techniques for the stockpiles
- Right of way and roadside debris (BMP 14.19)

3. Current Year's Mining Activities – Location and Schedule

A schedule of annual operations should be included as part of the annual Plan of Operations for placer mining, and as an update to the hardrock Plan of Operations.

- Map of the area to be mined or developed this year. Mining should be based on sample pits, trenches, or drilling where possible
- When equipment will be moved on and off site
- Timing of proposed mining activities near streams. Instream work on fish streams needs to be scheduled to minimize impacts on fish passage, and fish spawning and rearing habitat

4. Water quality monitoring:

- Location of sampling sites and sampling schedule for any water quality monitoring that is required of the operator
- Soil & Water Resource Monitoring Evaluation
- NPDES Permitting Process

IMPLEMENTATION. Description for mining site conditions, planning, design, and scheduling are given in each mining plan of operation. Responsibility for developing the Plan of Operation belongs to the individual operator and/or lessor. The District Ranger or staff is responsible for reviewing the plan and requesting additional information if necessary. Review can involve using a Forest Service interdisciplinary team.

The District Ranger acknowledges receipt of the Plan and informs operator that the:

1. Plan is approved; or
2. Operations are such that the operator does not need a plan; or
3. Plan needs to be modified or changed to include items necessary to meet the purpose of the regulations in 36 CFR 228 subpart A; or
4. Plan is being reviewed and additional time is needed to complete the review (cannot exceed 60 days); or

5. Plan cannot be approved until an FEIS is prepared and filed with the CEQ (36 CFR 228.5).

REFERENCES. 36 CFR 228, 36 CFR 251, and 30 U.S.C. 612; FSM 2810 and 2827; Reference Manual (Alaska Department of Fish and Game, Jan.1986), Alaska Statute 16.05.840 and 16.05.870. ANILCA (Public Law 96-487) sec 505.

17.2 – PRACTICE. Placer Mining – (NPDES) Permits.

OBJECTIVE. To incorporate soil and water resource considerations into NPDES Permits for placer mining plans of operation for placer mining.

EXPLANATION. This is an administrative and preventive practice. Mining Plan of Operations must explain the annual work, including reference to the handling processing and discharge of mining materials. For placer mining operations using mechanized equipment (including suction dredges), EPA requires the following best management practices be followed for issuance of a NPDES wastewater discharge permit:

1. Surface Water Diversion. The flow of surface water into the plant site shall be interrupted and these waters diverted around and away from incursion into the plant site.

2. Berm Construction. Berms, including any pond walls, dikes, low dams, and similar water retention structures shall be constructed in a manner such that they are reasonably expected to reject the passage of water.

3. Pollutant Material Storage. Measures shall be taken to assure that pollutant materials removed from the process water and wastewater streams will be retained in storage areas and not discharged or released to the waters of the United States.

4. New Water Control. The amount of new water allowed to enter the plant site for use in ore processing shall be limited to the minimum amount required as make-up water for processing operations.

5. Effluent Limitations. The concentration of pollutants discharged in process wastewater from an open-cut mine plant site shall not exceed an instantaneous maximum for: settleable solids of 0.2 milliliters per liter; turbidity of 5 NTU's above "natural" background; and total recoverable arsenic of 0.18 micrograms per liter with no "natural" background measurements.

6. Maintenance of Water Control and Solids Retention Devices. All water control devices such as diversion structures and berms, and all solid retention structures such as berms, dikes, pond structures, and dams shall be maintained to continue their effectiveness and to protect from unexpected and catastrophic failure. Water control and retention structures shall be designed and constructed to contain the design storm runoff event.

7. Seasonal Closure. The operator shall take whatever reasonable steps are appropriate to assure that, after the operating season, all mine areas, including ponds, are in a condition which

will not cause additional degradation to the receiving waters over those resulting from natural causes. (See BMP 17.5)

IMPLEMENTATION. Each mining operator is responsible to file for an NPDES wastewater discharge permit through the U.S. Environmental Protection Agency. The permit requires all mechanized placer mining operations to follow the practices listed above. Enforcement for compliance with these practices is the direct responsibility of the EPA; however, responsibility may also be taken by the ADEC, or by the Forest Service District Ranger or representative.

The District Ranger or representative can do the following in the event of operator non-compliance:

1. Issue non-compliance notice
2. Issue a citation
3. File a court injunction
4. Pursue civil and/or criminal prosecution.

These actions should be coordinated through the Forest Minerals Specialist.

REFERENCES. Federal Register, Vol. 53, No. 100, 5124188, Part 440, Subpart M, USEPA NPDES Permit No: AK-00.

17.3 – PRACTICE. Hard Rock Mining.

OBJECTIVE. To incorporate soil and water resource considerations into the planning process for mining plans of operation for lode mining operations.

EXPLANATION. Hard rock mining consists of developing a tunnel system or, for open pit, the extraction of lodes of ore-bearing rock. Areas of high-grade ore require little surface disposal of wastes; generally these wastes can be backfilled or contained in the areas where the ore has been removed. However, the majority of deposits contain low-grade ore combined with large amounts of waste rock. This requires surface disposal and presents a high potential for degradation of water quality from sedimentation and acid contamination. Drainage of water from the mine is another potential contaminate.

While most development at these sites is below ground, surface facilities include roads, dump or waste disposal areas, equipment storage and service sites, administrative buildings, and supply storage. Associated activities generally include milling operations. Waste disposal from mills present an even greater potential for adverse effects on water quality. Mill waste (tailings) is generally finely ground and transported and stored as a slurry. Storage is generally in surface ponds.

The following applies to hard rock mining operations:

1. Development of surface facilities should conform with appropriate practices as detailed in other chapters. These include measures to protect water quality during exploration, construction, and developmental activities. Related practices are: 12.8, 12.9, 12.10, 12.14, 12.15, 12.17, 14.6, 14.9, 14.15, 14,17, 14.18, 14.19, 14.20, 14.24, 16.4, and 16.5. In addition, practice 14.3 would apply to the location and design of saltwater transportation facilities.

2. Mine waste will be disposed of in a manner to prevent unacceptable damage to the soil and water resources and should include: location of the waste material where sedimentation potential is minimized; stabilization of waste material to prevent movement; treatment of waste with potential for acid production with lime or caustic soda to prevent leaching into surface or subsurface waters; and revegetation of waste disposal sites to prevent erosion.

3. Water from mines should be released slowly to reduce deposition of suspended particulate matter and the introduction of oxygen-deficient water into streams, and to prevent downstream flooding. Water that has become acidic should be treated prior to release. Mine water may be directly used in mill boilers where it may be recycled to reduce contamination of surface waters.

4. When feasible, mill tailings should be returned underground if they will not contaminate the groundwater. Surface disposal sites (ponds) should be sited to prevent embankment erosion by surface water and in a location to minimize flooding potential. Where necessary, construct catchment ponds downstream from the embankment to collect seepage and tailing eroded from the face of the embankment. Use decanting systems, as appropriate, to remove water from the pond after solids separation.

5. When toxic solutions, as a result of dissolved salts or metals, are found as leachates from tailings, monitor and treat effluent as required in NPDES Permits.

IMPLEMENTATION. The Forest Service will designate locations for facilities and waste and tailings disposal sites as identified in the environmental analysis. Detailed mitigation measures are developed by an interdisciplinary team during the environmental analysis and are incorporated into the plan of operations. The mining operator is responsible for the development of the operating plan with review and approval by the Forest Service.

REFERENCES. 36 CFR 228, Subpart A and FSM 2810.

17.4 – PRACTICE. Permits and Administration of Geophysical Operations.

OBJECTIVE. To protect the quality of surface and groundwater from degradation resulting from geophysical activities on National Forest System lands.

EXPLANATION. This is an administrative practice. Geophysical activities will be managed in a manner that is both timely and offers protection to other multiple-use values and management objectives.

Many activities have no effects. However, if effects are identified, standard seismic hole plugging procedures will be followed to prevent contamination of groundwater resources, and

shot hole placement will be examined for potential impacts to other resource values. New road construction, if allowed, will be located, designed, constructed, and maintained to protect the soil and water resources. Roads will be obliterated when no longer needed (BMP 14.24).

IMPLEMENTATION. During the environmental analysis, an interdisciplinary team will be assembled to prepare the appropriate NEPA document that evaluates potential impacts, including cumulative, and any needed mitigation measures for the geophysical prospecting permit. The use of water resources for prospecting activities may require non-Forest Service authorizations or permits.

REFERENCES. Organic Act of 1897 (30 Stat. 34, as amended, 16 U.S.C. 472, 475-478, 480-482, 551); Multiple Use—Sustained-Yield Act of 1960 (74 Stat. 215, 16 U.S.C. 528-531); RPA, as amended (88 Stat. 476; 16 U.S.C.1600-1614); FSM 2860.

17.5 – PRACTICE. Site Closure and Rehabilitation.

OBJECTIVE. To incorporate soil and water resource considerations into the planning process for mining Plan of Operation.

EXPLANATION. This is an administrative and corrective practice. Details of final site rehabilitation measures should be described and mapped in the mining Plan of Operation.

Emphasis should be given to steps for speeding site recovery and enhancing the value of rehabilitated areas to fish and wildlife. Topics addressed should include:

1. Stream rehabilitation, including drawings and descriptions of the final location and configuration for the active stream channel, and fish habitat features intended for the restored stream reach.

2. Floodplain rehabilitation, including: plans for final cleaning and/or stabilization of settling ponds; final configuration of drainage control structures; final site sloping and contouring for drainage control; distribution of stockpiled material; and revegetation sites in disturbed areas.

3. Spoils, waste rocks storage areas, and camp sites should be reshaped to provide proper surface drainage and erosion control. All disturbed areas should be stabilized by vegetation.

4. Tailing disposal sites should be reclaimed to prevent erosion and toxic leachates from entering surface drainages and aquifers. Reclamation measures include liming, contouring, capping and revegetation of tailing piles; use of interceptor ditches to divert surface runoff away from tailing disposal sites; and construction of internal drainage system to collect and safely dispose of water which infiltrates the tailings pile.

IMPLEMENTATION. A description of the site closure and rehabilitation plan is given in each mining Plan of Operation. Responsibility for developing the Plan of Operation belongs to the individual operator and/or lessor. The District Ranger or staff is responsible for reviewing the plan and requesting more detail if necessary. Review can involve using a Forest Service interdisciplinary team.

REFERENCES. 36 CFR 228, 36 CFR 251, and 30 U.S.C. 612; Reference Manual (Alaska Department of Fish and Game, January 1986), Surface Environment and Mining (SEAM) Reclamation Users Guide.

17.6 – PRACTICE. Abandoned Mine Land Reclamation.

OBJECTIVE. To reduce erosion and water quality degradation by sediment and toxic substances from abandoned mined lands and mining facilities through reclamation of these lands.

EXPLANATION. This is a corrective practice. Abandoned mined lands are frequently erosive, bare of vegetation, or are exuding toxic substances and/or sediment into nearby streams. Some sites may pose a threat to public health or safety. Reclamation plans for reducing impacts to soil and water resources are needed for each abandoned mine. Specific practices may vary from site to site, ranging from simple revegetation or reshaping with earth-moving equipment, to restoration to pre-disturbance conditions.

It is important that the site be revegetated with plant species that accomplish the purposes of reclamation. Species may be native or introduced and may be both live plants or seed. Fertility of soil and spoil materials and climate will affect species selection and survival, and soil amendment recommendations.

IMPLEMENTATION. This practice is typically implemented through the development of an inventory of all abandoned mined lands. If a soil and water resource problem area is observed and documented, an interdisciplinary team will assess that abandoned mine site, develop the necessary actions to correct the problem, and integrate them into the Forest Planning process for funding and execution. The NEPA process will be followed in the planning and implementation of reclamation measures. The Forest Service should work toward inclusion of the more important abandoned mined lands in State inventories and reclamation plans, since both the State and the Office of Surface Mining (OSM) can provide funding for State projects.

REFERENCES. FSM 2522, 6740, 7442, 7443, and 7460; Abandoned Mine Lands Reclamation Control Handbook, Office of Surface Mining; Surface Environment and Mining (SEAM) Reclamation User Guides.

D. GEOCHEMICAL CHARACTERIZATION OF ORE BODY

D. GEOCHEMICAL CHARACTERIZATION OF ORE BODY

BULK ORE AND ORE COMPOSITE CHARACTERIZATION

Kensington gold deposit occurs within a structurally sheared portion of the regionally metamorphosed Jualin Diorite stock. It has features typical of many mesothermal gold-quartz deposits, including a simple deposit mineralogy, an apparent absence of chemical zonation, a low sulfide content, and low abundances of most metals. Mineralization occurs within a north-trending, east-dipping zone of discontinuous, en echelon veins and vein swarms. A study identified seven stages of vein development, four of which produced precious metals mineralization with associated deposition of quartz and carbonate minerals (Coeur, 1996b).

Gold occurs predominantly as calaverite ($AuTe_2$) and less commonly as native gold, both of which are associated with pyrite (FeS_2) (Coeur, 1996b). In addition, rare grains of petzite (Ag_3AuTe_2) have been identified, along with coloradoite (HgTe) and altaite (PbTe). Chalcopyrite ($CuFeS_2$) occurs in minor quantities in association with rare bornite (Cu_5FeS_4), molybdenite (MoS_2), sphalerite (ZnS), galena (PbS), pyrrhotite (FeS), and pentlandite ((Fe, Ni) 9S8). Gangue minerals include quartz (SiO_2), calcite ($CaCO_3$), ankerite ($CaFe(CO_3)2$), dolomite ($CaMg(CO_3)2$), gypsum ($CaSO_4 \times 2H_2O$), mafic-silicate minerals (chlorite, epidote), and sericite. Secondary minerals identified in the altered diorite stock include biotite, feldspars (albite, orthoclase), oxides (magnetite, rutile), and sphene, in addition to the gangue minerals listed above.

Ore testing has included acid-base accounting, trace metals analysis, kinetic leach testing, and synthetic leach testing. Analytical samples were excavated in bulk from the deposit and obtained from drill cores; a blended ore composite sample used in pilot-scale bench testing of the present ore-processing method was synthesized from drill cuttings and mined samples.

Static Acid-Base Accounting Tests

Geochemica and Kensington Venture (1994) reported the total sulfur content, sulfide sulfur content, and the ratio of neutralizing potential to maximum potential acidity for 581 drill core samples collected from 39 boreholes; partial data are reported for 10 additional samples collected from these boreholes. For each borehole intercept, length-weighted total sulfur contents and ratios of neutralizing potential to maximum potential acidity were computed from the individual sample data. Most boreholes were drilled through the mineralized zone, roughly perpendicular to the orientation of ore body. Individual samples of NQ-diameter core (approximately 1.9 inch) had lengths of 2 to 5 feet.

Samples for sulfur analyses and acid-base accounting (ABA) tests were crushed to minus 80 mesh and analyzed following EPA protocols (PB-280-495) by Lakefield Research; certificates of analysis and sample locations are included in Geochemica and Kensington Venture (1994). Total sulfur contents were determined using a Leco furnace; sulfide sulfur was determined by weak acid leach-Leco; minimum detection limits are not stated for these analyses. Neutralizing

potentials were determined by reacting the sample with hydrochloric acid and back titrating the excess acid. Values for maximum potential acidity were computed from the total sulfur content. Results are reported as tons of $CaCO_3$ equivalent per kiloton of material.

Table D-1 summarizes ABA data for individual drill core samples, and Table D-2 summarized data for length-weighted drill core intercepts. The mean NP/MPA ratio of 16.01 computed for individual samples indicates that the ore samples are net neutralizing; however, there is considerable variability in the sample population, which is skewed toward higher values (the median ratio is 6.28). The histograms shown in Figure D-1 illustrate the distribution of NP/MPA ratios through the sample population. Only 8.1 percent of the samples have NP/MPA ratios less than 1, while an additional 21.8 percent have ratios between 1 and 3. The ABA profiles of these samples indicate that more test work is required to determine whether they are potentially acid generating. In contrast, 39.1 percent of the samples have NP/MPA ratios greater than 10. Length-weighted intercept ratios are markedly more consistent (range of 2.24 to 76.98), with only one intercept having a weighted ratio less than 3 (see Table D-2). Twenty-four of the 39 weighted borehole intercepts have ratios greater than 10 (median value of 12.68).

Kensington Venture (1992) conducted ABA tests on a sample of bulk ore excavated from the Kensington deposit (location and sample description were not provided). The sample has a neutralization potential of 132.9 tons equivalent per kiloton, an acid generation potential (AGP) of 16.4 tons equivalent per kiloton, and a computed NP/AGP ratio of 8.1.

Trace Metals and Bulk Compositional Analysis

Compositional analyses were performed on whole-rock samples obtained from drill core and cuttings and subsurface excavation. Samples were analyzed by Lakefield Research, Ltd. (Toronto, Canada), Barringer Laboratories, Inc. (Reno, Nevada), and N.A. Degerstrom (Spokane, Washington) using a variety of analytical techniques. This section summarizes data collected on bulk ore samples, metallurgical samples, and composite drill core intercepts.

Six bulk ore samples, ranging in size from 1.5 to 252 tons, were excavated from the Kensington deposit or synthesized from previously mined material and drill cuttings. The locations of bulk samples collected from the 2,050-foot adit, 800-foot adit, and Crosscut 2 are given in Kensington Venture (1994). The 252-ton sample from the 800-foot adit was excavated from the heart of the deposit; descriptions of the other samples were not provided. The composite bulk sample M1 was formulated in 1994 from material excavated from Crosscut 2 in 1991 (Coeur, 1996b). This 2.7-ton sample was used in ore processing and leaching tests at Degerstrom Labs. The composite sample M2 (also referred to as composite B) was excavated from Crosscut 2 in 1994 (Coeur, 1996b) and shipped to Lakefield Research for use in pilot milling studies. This 3.8-ton bulk sample, recovered from the mid-section of the deposit, contains quartz and carbonate veins and associated pyritic mineralization. In 1996, Montgomery Watson personnel formulated a 1.5-ton sample from previously mined samples collected in 1994 (Montgomery Watson, 1996b). This blended sample was sent to the Degerstrom facility for pilot-scale bench tests of the revised ore-processing method. Table D-3 summarizes trace metals analyses for the bulk ore samples.

Table D-1. Acid-Base Accounting Data for Individual Kensington Ore Samples Collected From Drill Core

	Total Sulfur						Sulfide Sulfur						NP/MPA					
Borehole	Mean	Std Dev	Median	Low	High	n	Mean	Std Dev	Median	Low	High	n	Mean	Std Dev	Median	Low	High	n
K-47-A	2.55	2.34	1.61	0.37	6.99	8	2.50	2.29	1.59	0.36	6.80	8	3.41	4.20	1.54	0.32	10.60	8
K-47B	1.83	1.55	1.50	0.40	5.05	7	1.72	1.59	1.20	0.39	5.05	7	3.45	3.11	2.90	0.29	9.65	7
K-48	0.79	1.14	0.45	0.05	6.08	29	0.72	1.14	0.40	0.04	5.96	30	16.97	18.48	11.20	0.58	96.60	29
K-93	1.81	2.06	1.28	0.03	10.40	25	1.66	2.06	1.03	0.02	10.40	25	8.11	21.75	3.16	0.22	111.50	25
K-94	0.99	1.80	0.17	0.03	7.26	19	0.88	1.61	0.15	0.03	6.53	19	35.08	38.37	27.40	0.46	142.60	19
K-96	0.86	1.17	0.44	0.06	4.98	43	0.60	1.07	0.19	0.02	4.85	43	11.99	9.81	10.70	0.05	56.10	43
K-101	1.42	1.49	0.85	0.17	5.32	17	1.29	1.47	0.73	0.15	5.32	17	7.82	7.17	5.26	0.75	24.70	17
K-126	1.46	1.73	1.08	0.14	8.68	24	1.31	1.76	0.90	0.10	8.68	24	6.54	7.02	4.09	0.23	27.00	24
K-132	0.74	0.51	0.54	0.24	1.32	5	0.73	0.51	0.52	0.24	1.32	5	8.49	9.99	5.15	0.57	25.20	5
K-135	2.80	5.05	1.51	0.04	22.00	18	2.63	4.86	1.31	0.03	21.00	18	14.34	30.35	3.94	0.14	131.20	18
K-138A	1.96	1.92	1.35	0.12	6.90	14	1.70	1.65	1.29	0.07	5.72	14	8.82	12.52	3.41	0.47	37.70	14
K-138B	1.67	1.63	0.77	0.15	3.63	7	1.64	1.63	0.77	0.13	3.63	7	11.80	14.94	4.06	1.05	40.30	7
K-145	1.55	2.02	0.76	0.09	11.00	37	1.41	1.82	0.58	0.05	9.81	37	10.64	12.04	5.29	0.53	39.40	37
K-156	1.45	1.72	0.55	0.13	5.83	21	1.44	1.71	0.56	0.13	5.71	21	11.51	9.56	10.50	0.66	35.10	21
K-158A	1.20	0.75	1.13	0.35	2.23	5	1.18	0.77	1.13	0.32	2.23	5	5.35	4.54	3.73	1.37	12.90	5
K-158B	1.16	0.88	1.09	0.29	3.28	17	1.09	0.81	1.03	0.28	3.00	17	7.42	5.85	6.17	0.93	18.90	17
K-170	0.74	1.32	0.11	0.03	2.71	4	0.61	1.06	0.11	0.03	2.19	4	41.70	32.44	45.15	1.48	75.00	4
K-180A	0.77	1.03	0.27	0.01	3.42	18	0.73	0.99	0.23	0.01	3.20	18	34.48	62.35	15.35	0.06	266.80	18
K-180B	2.24	1.42	2.19	0.62	3.96	4	2.22	1.45	2.19	0.55	3.96	4	2.40	2.32	1.57	0.66	5.80	4
K-190	2.39	2.26	2.18	0.24	6.19	6	2.32	2.26	2.06	0.18	6.15	6	4.35	5.27	1.80	0.24	13.40	6
K-193	1.00	1.29	0.75	0.02	4.93	13	0.92	0.94	0.72	0.02	3.54	14	28.70	65.26	6.77	1.44	242.50	13
K-222	0.93	1.72	0.40	0.03	8.55	25	0.79	1.55	0.34	0.03	7.55	25	21.70	31.58	10.40	0.35	149.70	25
K-256	1.37	1.11	1.06	0.06	3.23	6	1.17	0.94	0.88	0.05	2.54	5	12.72	22.93	4.35	1.12	59.40	6
K-267	0.97	1.18	0.26	0.05	3.47	13	0.85	1.07	0.21	0.04	3.37	13	21.32	22.75	16.15	1.02	72.30	12
K-328	1.25	1.41	0.90	0.12	4.79	10	1.22	1.43	0.87	0.08	4.79	10	5.59	7.15	2.87	0.44	21.90	10
K-366A	2.02	3.76	0.81	0.06	18.10	28	1.92	3.75	0.76	0.03	18.10	28	12.07	19.62	6.44	0.06	89.40	28
K-366B	1.49	0.28	1.55	1.18	1.73	3	1.39	0.25	1.41	1.13	1.63	3	4.09	0.38	4.21	3.66	4.40	3
K-386	0.69	0.48	0.59	0.03	1.38	9	0.66	0.46	0.59	0.03	1.38	9	14.50	21.40	5.44	2.11	68.00	9
K-388	0.81	1.34	0.30	0.02	4.61	11	0.78	1.29	0.27	0.02	4.45	11	41.81	60.57	18.70	1.67	208.60	11
K-389	0.80	1.08	0.29	0.04	2.86	7	0.73	1.03	0.28	0.03	2.86	7	37.79	44.58	20.80	2.31	118.50	7
K-394	2.48	4.78	0.13	0.03	9.65	4	2.47	4.79	0.12	0.01	9.65	4	43.43	35.54	48.50	0.43	76.30	4
K-398	1.30	1.59	0.61	0.08	5.23	22	1.21	1.53	0.49	0.05	4.94	22	10.89	12.56	4.73	0.33	40.00	22
K-403	0.71	0.58	0.57	0.03	2.24	22	0.65	0.55	0.51	0.02	1.99	22	17.69	27.44	6.73	0.86	117.40	22
K-404	0.29	0.37	0.19	0.03	1.02	6	0.25	0.33	0.16	0.03	0.91	6	66.66	63.29	38.85	4.37	150.60	6
K-407	0.98	0.95	0.61	0.11	3.27	17	0.94	0.92	0.59	0.09	3.18	17	9.44	11.19	6.40	0.83	48.00	17
K-410	1.89	1.21	1.56	0.22	3.88	13	1.79	1.14	1.50	0.22	3.88	13	5.77	6.64	4.38	1.04	26.50	13
K-414	1.02	1.48	0.45	0.11	4.53	8	0.92	1.36	0.39	0.10	4.14	8	18.80	18.43	15.50	0.77	58.80	8
K-416	0.65	0.94	0.35	0.03	3.86	18	0.59	0.94	0.26	0.02	3.83	18	35.02	47.86	12.70	0.84	150.20	18
K-430	1.20	1.23	1.09	0.05	5.68	19	1.14	1.17	1.09	0.05	5.41	19	12.48	21.35	3.69	0.38	83.80	19
Total	1.30	1.91	0.68	0.01	22.00	582	1.19	1.84	0.59	0.01	21.00	583	16.01	28.32	6.28	0.05	266.80	581

Notes:

Total sulfure and sulfide sulfure given in percent.

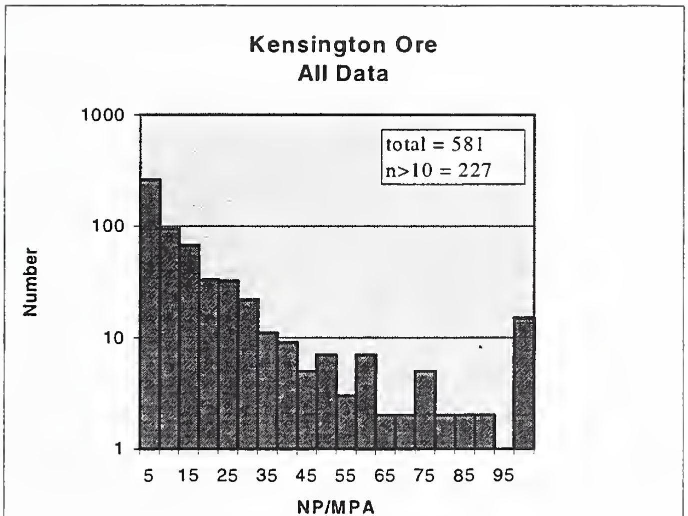
NP/MPA = Neutralization potential/maximum potential acidity.

Source: Geochemica and Kensington Venture, 1994.

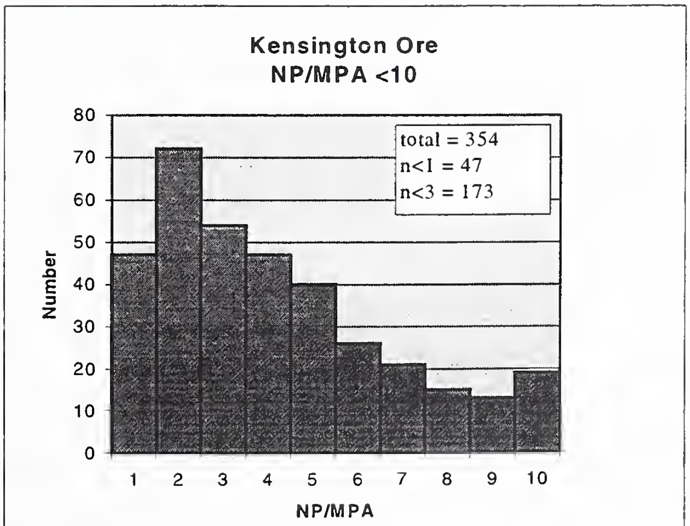
Table D-2. Acid-Base Accounting Data for Length-Weighted Ore Samples Collected From Drill Core

Borehole	Northing	Elev. (ft)	Ore Zone	Drilled		Length Weighted	
				From	To	Total S	NP/MPA
K-47A	70,500N	900	1	72	89	2.42	3.75
K-47B	70,500N	900	2	194	213	1.92	3.09
K-48	71,200N	900	1	182	283	0.71	16.17
K-93	71,000N	600	1	222	306	1.82	8.82
K-94	71,400N	2,200	3	264	347	0.99	37.24
K-96	71,000N	500	1	293	448	0.75	13.2
K-101	71,370N	2,300	3	574	661	1.36	7.33
K-126	71,200N	700	1	210	289	1.46	7.28
K-132	71,500N	1,100	4	240	257	0.79	7.36
K-135	71,200N	500	1	195	258	2.3	17.74
K-138A	71,500N	900	1	84	136	1.35	8.42
K-138B	71,500N	900	4	296	314	1.36	15.28
K-145	71,100N	1,000	1	142	255	1.3	12.68
K-156	71,300N	600	1	278	352	1.29	12.04
K-158A	71,500N	600	4	127	139	1.06	6.61
K-158B	71,500N	600	1	238	296	1.11	7.53
K-170	70,240N	1,100	2	204	218	0.83	41.2
K-180A	70,680N	1,200	1	183	249	0.77	41.77
K-180B	70,680N	1,200	2	289	303	2.23	2.24
K-190	70,500N	1,200	1	197	213	2.23	5.46
K-193	70,500N	1,400	1	275	313	0.83	31.25
K-222	70,500N	200	1	515	575	0.88	23.19
K-256	70,800N	1,500	1	130	145	1.28	11.15
K-267	71,100N	1,400	1	129	166	0.84	18.49
K-326	70,820N	100	1	1155	1197	1.28	5.34
K-366A	71,450N	1,300	1	183	262	1.81	12.5
K-366B	71,450N	1,300	4	372	380	1.46	4.05
K-386	70,600N	2,000	3	533	559	0.63	15.35
K-388	70,600N	2,400	3	411	448	0.93	41.28
K-389	70,500N	2,000	3	692	713	0.73	32.95
K-394	71,200N	2,200	3	364	374	2.95	41.65
K-398	71,000N	0	1	1078	1142	1.29	10.15
K-403	71,100N	2,200	3	370	429	0.67	19.51
K-404	71,100N	2,300	3	358	375	0.24	76.98
K-407	71,100N	2,400	3	377	448	0.97	9.24
K-410	70,900N	2,100	3	377	422	1.85	6.06
K-414	70,800N	2,200	3	354	386	1	19.91
K-416	71,160N	200	1	1043	1114	0.67	31.5
K-430	70,500N	2,300	3	469	527	1.06	14.99
Mean						1.27	17.97
Std. Dev.						0.59	15.46
Median						1.11	12.68
Low						0.24	2.24
High						2.95	76.98

Notes:
Total sulfur given in percent; drilled depths given in feet.
NP/MPA = neutralization potential/maximum potential acidity.
Source: Geochemica dn Kensington Venture, 1994



Data from Geochemica and Kensington Venture (1994).



Data from Geochemica and Kensington Venture (1994).

Figure D-1. Histograms of Acid-Base Accounting Analyses for Individual Kensington Ore Samples

Table D-3. Trace Metals Analyses for Bulk Ore Samples

Year	2050 Audit 1988	800 Audit 1989	Crosscut 2 1994	MI 1994	Composite B/ M2 1994	Blended Composite 1996
Tons	1.5	252	5	2.7	3.8	1.5
Lab[1]	LR	BL	BL	D	BL/LR	D
Source[2]	SRK	SRK	SRK	C	C	MW
Al			13050	14979	76000	
Sb	0		1	6	<2	2.7
As	0	0	3.7	7	10	9
Ba			87	116	1000	549
Be					<2.0	
Bi			0		<2	4
Cd			0	<1.0	<0.2	<0.1
Ca			25213	24375	32000	29000
Cr			11	13	18	42
Co			26	40	42	28
Cu	950	91	447	390	730	254
Au	0.141*	0.162*	0.198*	0.182	0.183	0.155*
Fe			4.37	7.7	5.3	4.5
La			3		3	
Pb	0		1	120	13	26
Mg			14613	10900	14000	13000
Mn			922	1100	1000	1351
Hg	0.4		0	0.17	<0.3	0.076
Mo	0		9	24	9	13
Ni			5	11	17	7
P			1171	1230	1171	
Se			0	<1.0	<3.0	<1.0
Ag	0	0.2	0.2	0.34	0.2	0.021*
Na			363	120	26000	
S	1.12	1.26		2.37	1.94	1.83
Te	0			5	11	13
Sn						
W			11		11	34*
V						55
Y			15		13	
Zn	70		49	73	110	64

Notes:

Analyses expressed in ppm, except Fe and S expressed in percent.

*Analysis expressed in ounces per ton.

1. LR = Lakefield Research, Ltd., Toronto, Ontario, Canada. BL = Barringer Laboratories, Inc., Reno, Nevada
   D = N.A. Degerstrom Labs, Spokane, Washington
2. Data sources: SRK = Steffen Robertson and Kirsten, 1996a; C = Coeur 1996b;
   MW = Montgomery Watson 1996b.

Drill core samples were collected for metallurgical testing and analyzed for trace metals from throughout the Kensington deposit. Barringer Labs in Reno, Nevada, and Lakefield Research, Toronto, Canada, analyzed 770 individual samples collected from 59 boreholes. Length-weighted trace metal contents were computed across the mineralized zone for each borehole intercept. Table D-4 summarizes the analytical methodology and minimum detection limits for each lab. Table D-5 presents the analytical results for the drill core samples.

Kinetic Humidity Cell Leach Testing

Kinetic humidity cell leach tests were performed on duplicate splits of a sample of ore composite B (Lakefield Research, 1995, in SRK 1996a). Testing was conducted for 20 weeks following EPA protocols. Leachate samples were extracted weekly and analyzed for oxidation-reduction potential, conductivity, alkalinity, acidity, and sulfate content. Leachate samples extracted at 4-week intervals were analyzed for trace metals.

As shown in Table D-6, results of the humidity cell tests show that pH, alkalinity, conductivity, and oxidation-reduction potentials are comparatively constant over the duration of the testing; sulfate concentrations are somewhat more variable. Table D-6 also shows that most analyte concentrations remain comparatively constant following the initial flush (week 0).

Meteoric Water Mobility Testing

Kensington Venture (1992) submitted a sample of ore material collected during bulk sampling of the ore body to a Meteoric Water Mobility Test (MWMT). Hibbs Analytical Labs analyzed the extract produced during the test using a variety of EPA procedures. Certificates of analysis and a summation of the procedures used are included in SRK 1996a. Data regarding sample size, location, and manner of collection were not reported. Table D-7 presents the MWMT results.

Toxicity Characteristic Leaching Procedure Test

One sample of ore material collected during bulk sampling of the ore body was subjected to an EPA method 1311 Toxicity Characteristic Leaching Procedure (TCLP) test (Kensington Venture, 1992). Certificates of analysis for the test, which was conducted by Hibbs Analytical Labs, are included in SRK 1996a. Data regarding sample size, location, and manner of collection are not provided. Table D-7 summarizes the results of the TCLP test.

Table D-4. Analytical Methodology and Minimum Detection Limits

Element	Barringer Labs	Lakefield Research	Min. Detection Limit (ppm)	
			Barringer	Lakefield
Al	n.a.	ICP	n.a.	20
Sb	AA	ICP	1	20
As	AA	AA	2	1
Ba	n.a.	ICP	n.a.	5
Be	n.a.	ICP	n.a.	5
Bi	AA	n.a.	1-2	n.a.
Cd	n.a.	ICP	n.a.	5
Ca	n.a.	ICP	n.a.	20
Cr	n.a.	ICP	n.a.	5
Co	n.a.	ICP	n.a.	5
Cu	AA	ICP	1	5
Au	GRAV	n.a.	--	n.a.
Fe	n.a.	ICP	n.a.	5
La	n.a.	ICP	n.a.	20
Pb	AA	AA	1	10
Mg	n.a.	ICP	n.a.	10
Mn	n.a.	ICP	n.a.	5
Hg	HYG	AA	0.01	0.3
Mo	AA	ICP	1	10
Ni	n.a.	ICP	n.a.	5
P	n.a.	ICP	n.a.	5
Se	n.a.	ICP	n.a.	1
Ag	AA	ICP	0.1	20
Na	n.a.	ICP	n.a.	10
S	LECO	LECO	100	100
Te	AA	ICP	2	10
Sn	AA	ICP	10	20
W	COL	n.a.	4	n.a.
Y	n.a.	ICP	n.a.	5
Zn	AA	ICP	1	5

Notes:

AA = atomic absorption spectroscopy; ICP = inductively coupled plasma spectroscopy; LECO = Leco sulfur/carbon analysis; HYG = hydride generation; GRAV = gravimetric fire assay; COL = colormetric; n.a. = not applicable; -- = not stated.

Source: Modified from Kensington Venture, 1994.

Table D-5. Drill Core Sample Analytical Results

Element	Individual Drill Core Samples[1]					Length-Weighted Drill Core Composites[2]							
	Mean	Std Dev	Low	High	n	Mean	Std Dev	Median	Low	High	n	n<MDL	MDL
Al						72288	15619	75809	14352	90178	21		
Sb - BL[3]	1.2	17.5	<1	450	725	<1		<1	<1	9	35	32	1
Sb - LR[3]						<20		<20	4	<20	19	18	20
As	1.6	14.9	<20	388	753	1.5	2	<1	<1	14	59	33	1
Ba	641.1	273.3	<5	3080	213	636.9	198.4	619.8	175.9	1142	21		
Be	<5		<5	<5	211	<5					21	21	5
Bi	<1		<1	1	333	<1					18	18	1
Cd	7.6	6.7	<5	30.2	213	6.8	5.3	3.8	0.5	15.3	21	7	5
Ca						46086	13796	46508	5280	69516	21		
Cr	71	4	<5	554	275	78	106	31	1	374	23		
Co	23	13	<5	97	278	26	9	27	8	43	23		
Cu	205	514	<1	7820	763	210	242	148	19	1406	59		
Au						0.196	0.193	0.135	0.007	1.189	59		
Fe	4.7	1.29	0.49	11.1	210	4.7	1.16	4.67	1.62	8.25	21		
Pb - BL[3]	6.2	63.6	<1	1680	751	2	1.1	2	<1	6	40	3	1
Pb - LR[3]						26.5	53.8	<10	3	240	19	9	10
Mg						13038	3743	13278	2692	21999	21		
Mn	1675	539	159	3921	210	1657	300	1636	1137	2484	21		
Hg	0.18	0.85	<0.01	10.88	696	0.162	0.212	0.088	0.01	1.049	53	4	0.3
La						<20					21	21	20
Mo - BL[3]	6	13	<1	130	483	9.4	9	7.5	1.3	44.2	21		
Mo - LR[3]						<20		<20	0.5	53.1	19	17	20
Ni	49	92.1	<5	406	275	53	86.3	<5	2	277	23	11	5
P						1603	614	1412	332	2601	20		
Se	0.08	0.39	<1	3	211	0.3	0.2	0.4	0	0.6	21	7	1
Ag	0.85	9.51	<0.1	231	634	1.47	6.3	0.22	0	45.4	52	3	0.1
Na						21316	5817	20890	3753	28950	21		
S	1.28	1.93	<0.01	22	707	1.29	0.73	1.09	0.26	2.95	42		
Te - BL[3]						7.55	10.86	4.51	0.11	64.11	39	6	2
Te - LR[3]						6.86	4.26	<10	2.11	14.62	17	4	10
Sn[3]						<20				0	<20	29	26
W						<4			0.1	<4	4	3	4
Y	12.4	4.1	<5	21	213	12.1	2.9	13	4	17	21		
Zn	54.6	76.9	<1	2004	747	58.6	42.5	49.2	8	324	59		

Notes:

1. Data are from Kensington Venture (1994) and Coeur (1996b). All analyses expressed in ppm except sulfur and iron expressed in percent. For values below detection limit, statistics computed using a value of 0.
2. Data are from Coeur (1996b). All analyses expressed in ppm except sulfur and iron expressed in percent. MDL = minimum detection limit. n<MDL = number of data points below minimum detection limit. For values below detection limit, statistics computed using a value of one half the detection limit.
3. BL = Analyses conducted by Barringer Laboratory, Inc., Reno, NV. LR = Analyses conducted by Lakefield Research, Ltd., Toronto, Ontario, Canada.

Table D-6. Humidity Cell Tests

Analyses of Duplicate Samples Measured Weekly for 20 Weeks Plus Initial Flush							
		Mean	**Std. Dev.**	**Median**	**Low[1]**	**High[1]**	
pH		7.83	0.49	7.77	6.94 (14)	8.93 (18)	
emf (mv)		302	59	300	206 (3)	466 (11)	
conduct. (mmhos/cm)		148	86	116	53 (10)	386 (1)	
SO_4 (mg/L)		42.3	30.3	31.6	12.5 (10)	146.0 (16)	
alkalin. [2] (mg/L)		12	4	10	8 (15)	29 (0)	
Average of Duplicate Analyses[3]							
week	0	4	8	12	16	20	
pH	8.34	8.1	8.02	7.82	7.67	8.5	
emf	221	304	336.5	348	337	229	
conduct.	313	134	118	162	149	152	
SO_4	76.5	43.7	34.7	59.3	122.7	13	
alkalin.	27.5	9.5	9.5	11	10.5	10.5	
Al	0.06	0.06	0.17	0.04	0.08	0.02	
Ba	0.032	0.019	0.017	0.01	0.023	0.008	
Ca	37	19	15.2	23.5	38.2	7.9	
Cu	0.005	<0.003	0.009	0.005	0.004	<0.003	
Mg	6.36	1.58	1.92	2.48	4.27	1.03	
Mn	0.28	0.055	0.07	0.047	0.094	0.05	
Na	3.96	1.08	1.22	1.59	1.81	0.46	
Si	0.33	0.24	0.26	0.31	0.3	0.14	
S	34.7	14.7	12.7	17.5	33.5	4.6	
Analytes at Concentrations Below Minimum Detection Limits[3]							
	MDL	**Max. Value[4]**	**n > MDL[5]**		**MDL**	**Max. Value[4]**	**n > MDL[5]**
Sb	0.02	0.04	3	Mo	0.007	0.064	4
As	0.01	0.07	4	Ni	0.01	0.11	3
Be	0.001	<0.001	0	P	0.03	<0.03	0
Cd	0.002	0.004	3	Se	0.02	0.06	4
Co	0.004	0.02	4	Sn	0.02	0.03	2
Cr	0.004	<0.004	0	Te	0.04	0.04	1
Fe	0.003	0.063	4	Zn	0.004	<0.004	0
Pb	0.02	0.07	4				

Notes:

1. Number in () is week of test in which value was recorded.
2. Alkalinity given in $CaCO_3$ equivalent.
3. All values in mg/l except pH (standard units), alkalinity (mg/l $CaCO_3$ equivalent), emf (mV), conductivity (mmhos/cm).
4. Highest analyzed concentration.
5. Number of analyses exceeding detection limit (12 analyses total). Data are from Lakefield Research (1995) as reported in SRK (1996a).

Table D-7. Meteoric Water Mobility Test Results

	MWMT[1]	TCLP[1]
Sb	0.01	--
As	--	0.007
Ba	--	3.3
Be	<0.010	--
Cd	--	0.048
Ca	35.8	--
Cr	--	<0.10
Co	<0.02	--
Cu	<0.01	--
Fe	0.23	--
Pb	--	0.1
Mg	11.3	--
Mn	<0.05	--
Hg	--	0.0008
Mo	<0.20	--
Ni	<0.02	--
K	49	
Se	--	<0.005
Ag	--	0.015
Na	12.5	--
Sr	15	--
Zn	0.007	--
Alkalinity	77	--
Chloride	3	--
Fluoride	0.34	--
Nitrate-N	5.1	--
Cyanide	0.009	--
Phosphate	<0.05	--
Sulfate	123	--
pH	7.3	--

Notes:

1. All analyses expressed in mg/l, except pH expressed in standard units. Data are from Kensington Venture (1992).
2. Modified EPA method 1312 leach test. All analyses expressed in mg/l. Flotation concentrate produced from blended ore composite sample by Montgomery Watson. Data are from SRK (1996a).

E. SURFACE WATER QUALITY

E. SURFACE WATER QUALITY

SURFACE WATER QUALITY AND MONITORING

A program to characterize the existing surface water quality in the project area was established at the Kensington Mine Project site in 1987. Stations were located to monitor the quality of water discharged as mine drainage and from settling ponds and to determine the baseline water quality in undisturbed portions of the Sherman Creek basin. For purposes of comparison, water quality also was monitored in the adjacent, undisturbed Sweeny Creek basin. Results of the surface water quality monitoring program through October 1995 are presented in Montgomery Watson (1996a); data through June 1996 are presented in Montgomery Watson (1996c). More detailed discussion of the surface water monitoring program is presented in Montgomery Watson (1996a; 1996b) and in the *Technical Resource Document for Water Resources, Kensington Mine Project* (SAIC, 1997).

Figure E-1 shows and Table E-1 summarizes the locations of the surface water monitoring stations. Note that station 109 replaced station 104 in August 1988. Both are located in upper Sherman Creek, upstream of the access road. The new station, located approximately 100 yards downstream of the old station, was positioned in a reach with a more stable streambed.

Since mid-1988, samples of surface water have been collected monthly at all stations during their period of record, except station 101A, which was sampled on a less regular schedule. Samples were collected by Kensington Joint Venture staff prior to December 1995 and have been collected by Montgomery Labs personnel since that time. Portable equipment was used to

Table E-1. Surface Water Quality Monitoring Stations

Station Number	Location	Period of Record
101	Outfall of existing mine drainage settling ponds	6/88 - present
101A	Outlet of 800-foot adit	9/87 - 6/89
102	South tributary of Ophir Creek, upstream of settling ponds	6/88 - 6/89
103	South tributary of Ophir Creek, downstream of settling ponds	11/87 - present
104	Upper Sherman Creek, upstream of access road	10/87 - 8/88
105	Lower Sherman Creek, below falls	9/87 - present
106	Lower Sweeny Creek	9/87 - present
108	Outlet of 2,050-foot adit	7/88 - 6/93
109*	Upper Sherman Creek, upstream of access road	8/88 - 9/94
110	North tributary of Ophir Creek, upstream settling pond discharge	4/91 - present

*Located 100 m downstream of station 104.

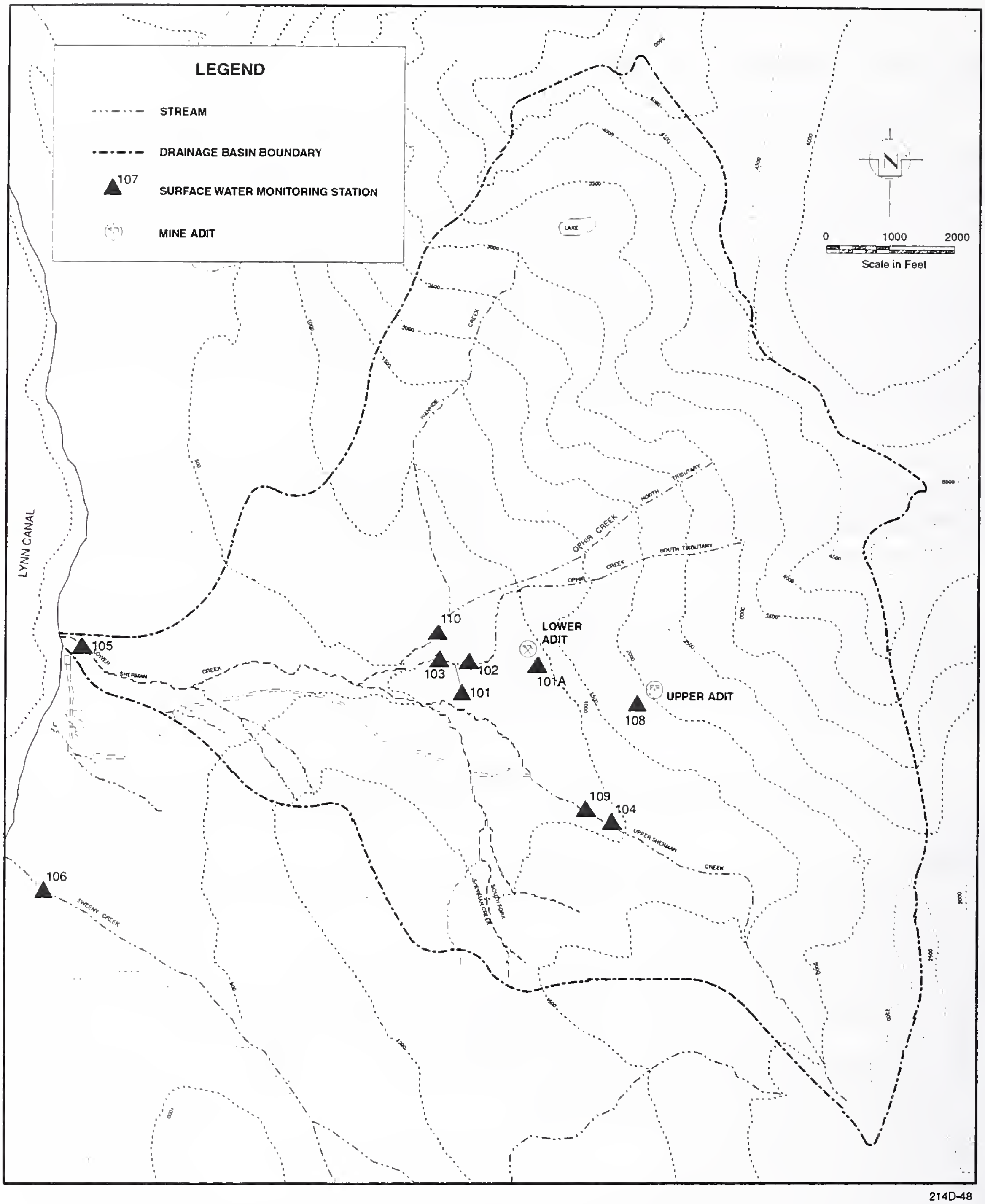


Figure E-1. Sherman Creek Drainage and Surface Water Monitoring Stations (Source: Adapted from Montgomery Watson, 1996a and SRK, 1996d)

measure pH, turbidity, water temperature, and specific conductance in the field. Samples were filtered in the field through elements with 0.45 mm pore diameters to prepare them for analysis of dissolved constituents. From 1987 to 1993, field-cleaned, reusable filters were used to process samples; since 1993, single-use, disposable filters have been used. Whenever possible, stream flow was recorded concurrently with sample collection. Flow rates were measued periodically in the field at stations 101, 103, 106, 109, and 110. A permanent recording gauge installed along lower Sherman Creek (station 105) in October 1989 has provided a continuous record of stream flow for the drainage basin.

Two laboratories have analyzed samples collected for surface water quality. Intermountain Laboratories (IML) in Sheridan, Wyoming, conducted chemical analyses from 1987 to November 1994. Montgomery Laboratories (ML) in Juneau, Alaska, conducted sample analyses from June 1993 to present. From July 1993 through November 1994, ML and IML periodically performed duplicate analyses of surface water samples, which were conducted to assess analytical consistency between the two laboratories. The results were reasonably consistent for the five constituents analyzed (i.e., As, Cu, Pb, Hg, and hardness).

Laboratory work was performed in accordance with 40 CFR Part 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants* and EPA *Methods for Chemical Analysis of Water and Wastes.* As a check on analytical accuracy, both labs routinely performed analyses of blanks and synthesized standards of known composition; sample analyses were corrected accordingly as required by EPA quality assurance/quality control procedures. Table E-2 the analytical methods and reporting limits of both labs. Note that analytical methods have improved with time, showing a general trend toward lower reporting limits.

The water quality monitoring effort focused primarily on trace metals, which typically occur in concentrations at or near their method detection limits. Nitric and hydrochloric acid digestion of samples was used for analyses of total recoverable metals. Raw analytical data show that dissolved metals concentrations are occasionally reported at levels higher than total metals concentrations. This is particularly true of samples collected during 1993. Montgomery Watson (1996a) discusses this apparent inconsistency, which could result from sample contamination, inappropriate analytical procedures, or overlapping analytical tolerances. While some inconsistent analyses are likely due to overlapping analytical tolerances at concentrations near the method detection limits, the switch from reusable to disposable filters in 1993 corresponded to the near elimination of inconsistent analyses.

Table E-3 summarizes sample analyses conducted through October 1995 for each surface water monitoring station and presents analyses from stations 104 and 109 combined as station 109. Analytical data were screened and evaluated prior to their inclusion in the table. Duplicate analyses were evaluated using a protocol that gave priority to detected values with the lowest reporting limit. Analyses with inconsistent values between dissolved and total metals were screened using maximum tolerance limits. Fifty-two analyses, representing less than 0.001 percent of the raw data, with values outside of their computed tolerance limits were removed from the data base. Ten surface water temperature measurements recorded as zero values between the months of April and October were considered implausible and removed from the data base; zero values recorded in the winter months were not removed.

Table E-2. Laboratory Methods, Reporting Limits, and Reporting Periods

Parameter	Intermountain Laboratories			Montgomery Laboratories		
	Analysis Method	Analysis Period	Reporting Limit	Analysis Method	Analysis Period	Reporting Limit
Aluminum (µg/l)	EPA 200.7	06/88-11/94	100	EPA 202.1	07/93-11/95	500
Arsenic (µg/l)	EPA 206.2	09/87-11/94	5	EPA 200.9	07/93-09/93	5
	---	---	---	EPA 206.2	10/93-10/95	0.5
Barium (µg/l)	EPA 200.7	06/88-11/94	500	EPA 208.1	07/93-10/95	500
Cadmium (µg/l)	EPA 213.2	09/87	0.5	EPA 200.9	07/93-09/94	1
	EPA 213.2	10/87-09/91	2	EPA 213.2	10/94-10/95	0.2
	EPA 213.2	10/91-11-94	0.5	---	---	---
Chromium (µg/l)	EPA 200.7	09/87	1	EPA 218.1	07/93-02/95	50
	EPA 200.7	10/87-06/89	5	EPA 218.1	03/95-10/95	20
	EPA 200.7	10/87-09/91	20	---	---	---
	EPA 200.7	10/91-11/94	10	---	---	---
Copper (µg/l)	EPA 200.7	09/87-06/89	2	EPA 200.9	07/93-09/94	20
	EPA 200.7	06/88-09/91	10	EPA 220.1	10/94-10/95	2
	EPA 200.7	10/91-11/94	5	---	---	---
Iron (µg/l)	EPA 200.7	09/87-11/88	10	EPA 236.1	07/93-03/95	100
	EPA 200.7	12/88-11/94	50	EPA 236.1	02/95-10/95	50
Lead (µg/l)	EPA 239.2	09/87	2	EPA 200.9 &	07/93-10/95	2
	EPA 239.2	10/87-11/88	10	239.2	---	---
	EPA 239.2	12/88-09/91	20	---	---	---
	EPA 239.2	10/91-11/94	1	---	---	---
Manganese (µg/l)	EPA 200.7	07/87-06/89	2	EPA 243.1	07/93-02/95	20
	EPA 200.7	06/88-11/94	20	EPA 243.1	03/95-10/95	15
Mercury (µg/l)	EPA 245.1	09/87-09/91	1	EPA 245.2	07/93-09/94	2
	EPA 245.1	11/91-11/94	0.1	EPA 245.2	10/94-10/95	0.2
Molybdenum (µg/l)	EPA 200.7	12/88-11/94	20	EPA 246.1	07/93-10/95	500
Nickel (µg/l)	EPA 200.7	09/87	2	EPA 200.9	07/93-02/95	20
	EPA 200.7	10/87-11/94	10	EPA 249.2	03/95-10/95	10
Selenium (µg/l)	EPA 270.2	09/87	2	EPA 200.9 &	07/93-10/95	5
	EPA 270.2	10/87-11/94	5	270.2	---	---
Silver (µg/l)	EPA 200.7	09/87	1	EPA 200.9	07/93-09/94	50
	EPA 200.7	10/87-11/87	2	EPA 272.1	10/94-10/95	0.5
	EPA 200.7	12/88-09/91	10	---	---	---
	EPA 200.7	10/91-11/94	0.1	---	---	---
Zinc (µg/l)	EPA 200.7	09/87-06/89	2	EPA 289.1	07/93-02/95	20
	EPA 200.7	06/88-11/94	10	EPA 289.1	03/95-10/95	10
Cyanide, free (µg/l)	EPA 335.3	12/89-10/90	5	No Analysis		
Cyanide, WAD (µg/l)	EPA 335.3	12/89-10/90	5	No Analysis		
Cyanide, total (µg/l)	EPA 335.3	12/89-10/90	5	No Analysis		
Ortho-Phosphate (µg/l)	EPA 365.1	09/87-06/89	5	EPA 365.1	07/93-10/95	50
	EPA 365.1	09/88-11/94	10	---	---	---

Table E-2. Laboratory Methods, Reporting Limits, and Reporting Periods (continued)

Parameter	Intermountain Laboratories			Montgomery Laboratories		
	Analysis Method	Analysis Period	Reporting Limit	Analysis Method	Analysis Period	Reporting Limit
Nitrite-Nitrogen (µg/l)	EPA 300.0	09/87-06/89	5	EPA 354.1	07/93-03/94	100
	EPA 300.0	06/88-11/94	10	EPA 300.0	04/94-09/95	200
	---	---	---	EPA 300.0	10/95	100
Nitrate-Nitrogen (µg/l)	EPA 353.1	09/87-06/89	200	EPA 353.2,3	07/93-03/94	100
	EPA 353.1	06/88-11/94	10	EPA 353.2,3	04/94-09/95	200
	---	---	---	EPA 353.2,3	10/95	100
Nitrite+Nitrate	EPA 353.2	06/88-11/94	10	ML/EPA 353.2	07/93-08/94	300
Nitrogen (µg/l)	---	---	---	EPA 300.0	09/94-09/95	400
	---	---	---	EPA 353.2	10/95	200
Ammonium	EPA 350.1	09/87-01/89	50	ML/EPA 350.1	07/93-09/95	50
Nitrogen (µg/l)	EPA 350.1	06/88-11/93	10	---	---	---
	EPA 350.1	01/94-11/94	50	---	---	---
Boron (mg/l)	EPA 200.7	01/88-11/94	0.01	ML 6010, 200.7	07/93-10/95	0.05
	---	---	---	EPA 212.3	11/93-10/95	0.05
Sodium (mg/l)	SM 325B	12/88-11/94	0.2	EPA 273.1	07/93-10/95	1.0
Potassium (mg/l)	SM 322B	05/89	0.1	EPA 258.1	07/93-10/95	1.0
	SM 322B	09/88-05/94	0.2	---	---	---
Calcium (mg/l)	EPA 215.2	08/88-11/94	1.0	EPA 215.1	07/93-11/93	1.0
	---	---	---	EPA 215.1	12/93-10/95	1.0 to 2.0
Magnesium (mg/l)	SM 318C	09/88-11/94	1.0	EPA 242.1	07/93-10/95	1.0
Fluoride (mg/l)	EPA 340.2	09/88-11/94	0.2	SM 4500-FC	07/93-10/95	0.1
Chloride (mg/l)	EPA 325.3	12/89-11/94	1.0	EPA 325.3	07/93-03/94	1.0
	---	---	---	EPA 300.0	04/94-09/95	2.0
	---	---	---	EPA 300.0	10/95	1.0
Sulfate (mg/l)	EPA 375.3	09/87-11/94	1.0	EPA 300.0	07/93-11/93	2.0
	---	---	---	EPA 300.0	12/93-09/95	4.0
	---	---	---	EPA 300.0	10/95	2.0
Hydroxide (mg/l)	EPA 310.1	10/90-11/94	1.0	EPA 310.1	07/93-10/95	0.001
Carbonate (mg/l)	EPA 310.1	12/88-11/94	1.0	EPA 310.1	07/93-10/95	0.001
Bicarbonate (mg/l)	EPA 310.1	12/88-11/94	1.0	EPA 310.1	07/93-10/95	0.001
Total Alkalinity (mg/l)	EPA 310.1	12/88-11/94	1.0	EPA 310.1	07/93-10/95	2.0
Acidity (mg/l)	EPA 305.1	12/88-11/94	1.0	EPA 305.1	07/93-12/94	2.0
	---	---	---	EPA 305.1	01/95-10/95	10
Hardness (mg/l)	EPA 130.2	12/88-11/94	1.0	ML/SM 2340B	07/93-10/95	1.0
pH (s.u.)	EPA 150.1	09/87-11/94	0.1	EPA 150.1	07/93-10/95	0.001
TDS (mg/l)	EPA 160.1	06/88-11/94	1.0	ML/EPA 160.1	07/93-08/94	10
	---	---	---	ML/EPA 160.1	09/94-10/95	20
Conductivity (µmhos/cm)	EPA 120.1	09/87-11/94	1.0	EPA 120.1	07/93-10/95	4.0
TSS (mg/l)	EPA 160.2	09/88-11/94	1.0	EPA 160.2	07/93-10/95	4.0
Turbidity (NTU)	EPA 180.1	08/88-11/94	0.05	EPA 180.1	07/93-10/95	0.05
Sett. Solids (ml/l)	EPA 160.5	12/88-11/94	0.1	EPA 160.5	07/93-10/95	0.1
SAR (units)	Calculated	12/88-11/94	NA	Calculated	07/93-05/94	0.0000
	---	---	---	Calculated	06/94-10/95	0.0001

Table E-3. Summary of Surface Water Data (August 1987 - October 1995)

Station[a, b, c]		As (µg/l)	Cd (µg/l)	Cr (µg/l)	Cu (µg/l)	Pb (µg/l)	Hg (µg/l)	Ni (µg/l)	Se (µg/l)	Ag (µg/l)	Zn (µg/l)	NO_3-N (µg/l)	NH_4-N (µg/l)	pH (s.u.)	TDS (mg/l)	TSS (mg/l)
Station 101	Mean	1.9	NA	NA	9.0	1.3	NA	NA	NA	0.12	11	2,775	1,793	7.9	539	12
	Min	0.7	*<0.2*	*<10*	2.7	1	*<0.05*	*<10*	*<5*	0.1	10	10	10	6.8	70	1
	Max	5.6	*<2*	*<50*	150	20	*<1*	*<20*	*<5*	1	60	39,100	22,600	8.3	1,268	140
	Detects	19	0	0	21	17	0	1	0	17	30	78	60	89	86	63
	Non-detects	55	74	74	53	57	74	73	74	57	44	10	24	0	0	24
Station 101A	Mean	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	7.2	93	NA
	Min	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*<200*	*<10*	6.7	74	NA
	Max	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	*200*	*<50*	7.6	140	NA
	Detects	0	0	0	0	0	0	0	0	0	0	1	0	5	5	0
	Non-detects	0	0	0	0	0	0	0	0	0	0	4	5	0	0	0
Station 102	Mean	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	637	NA	7.2	28	NA
	Min	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10	*<10*	7.0	22	0
	Max	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2,510	*57*	7.6	41	13
	Detects	0	0	0	0	0	0	0	0	0	0	6	1	6	4	2
	Non-detects	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0
Station 103	Mean	1.8	NA	NA	4.1	4.4	NA	NA	NA	0.17	12	3,169	718	7.3	243	3.6
	Min	0.59	*<0.2*	*<10*	2.1	1	*<0.05*	*<10*	*<5*	0.1	10	90	20	5.7	31	1
	Max	50	*<2*	*<50*	50	217	*<1*	*<20*	*<5*	1.1	60	36,000	9,590	8.0	996	33
	Detects	11	1	0	15	17	0	3	0	14	30	84	59	93	90	50
	Non-detects	60	70	71	56	54	71	68	71	57	41	8	29	0	0	34
Station 105	Mean	0.47	NA	NA	3.1	1.1	NA	NA	NA	0.09	7.7	774	54	7.4	71	4.2
	Min	0.55	*<0.2*	*<10*	2.3	1	*<0.05*	*<10*	*<5*	0.1	10	10	6	6.0	22	1
	Max	0.81	*<2*	*<50*	30	36	*<1*	*<20*	*<5*	1.1	50	19,200	350	8.0	194	120
	Detects	6	0	1	13	12	0	2	0	10	19	81	50	92	88	47
	Non-detects	64	70	69	57	58	70	68	70	60	51	10	37	0	2	36
Station 106	Mean	NA	NA	NA	5.3	5.4	NA	NA	NA	0.13	7.5	419	65	7.4	65	4.6
	Min	*<0.5*	*<0.5*	*<10*	5	1	*<0.05*	*<10*	*<5*	0.1	10	15	10	6.3	20	1
	Max	*5*	*<2*	*<50*	25	256	*<1*	*<20*	*<5*	1.1	40	14,200	1,120	8.1	130	85
	Detects	5	2	0	14	15	0	5	0	12	17	71	45	82	79	47
	Non-Detects	55	58	60	46	45	60	56	60	48	43	11	37	0	0	25
Station 108	Mean	NA	NA	NA	6.4	0.74	NA	NA	NA	0.19	8.3	122	39	7.6	57	5.7
	Min	*<5*	*<0.5*	*<10*	5	1	*<0.1*	*<10*	*<5*	0.1	10	10	40	7.0	26	1
	Max	*<5*	*3.4*	*<10*	19	4	*<0.1*	*<10*	*<5*	0.7	20	310	120	7.9	102	28
	Detects	0	1	0	7	3	0	0	0	7	5	16	6	17	14	12
	Non-detects	11	10	11	4	8	11	11	11	4	6	1	11	0	0	3
Station 109	Mean	1.2	NA	NA	4.3	0.76	NA	NA	NA	0.11	7.0	459	60	7.4	54	3.4
	Min	0.5	*<0.5*	*<10*	5	1	*<0.05*	*<10*	*<5*	0.1	10	10	10	5.7	16	1
	Max	2.8	*<2*	*<50*	30	3	*<1*	*20*	*<5*	1.3	30	15,500	1,380	7.85	110	73
	Detects	13	1	0	11	13	0	4	0	10	16	77	36	78	78	52
	Non-detects	47	59	60	49	47	60	56	60	50	44	1	42	0	0	19
Station 110	Mean	NA	NA	NA	4.3	3.9	NA	NA	NA	0.1	10	214	55	7.4	31	1.7
	Min	*<0.5*	*<0.2*	*<10*	2	1	*<0.05*	*<10*	*<5*	0.1	10	30	20	6.7	8	1
	Max	*<5*	*<2*	*<50*	41	186.5	*<1*	*<20*	*<5*	1.7	150	535	670	7.7	80	8
	Detects	1	1	0	13	10	0	1	0	9	14	45	24	54	48	24
	Non-detects	53	53	54	41	44	54	53	54	45	40	8	25	0	6	30

a. Minimum and maximum detected values are shown for sets with sufficient data for robust statistical analysis. Italics indicate overall minimum and maximum values (considering non-detects) for sets with insufficient data for robust statistical analysis.

b. NA - "No Data Available for Analysis" indicates no analyses were conducted for constituent.

c. All metals are total recoverable.

Source: Montgomery Watson (1996).

The data presented in Table E-3 were analyzed using a statistical method that uses a distribution/substitution technique developed for analyzing data with a large number of non-detect values and multiple detection limits. EPA Region 10 and ADEC accepted the method, which was developed by Helsel and Cohn (1988) and Helsel (1990), for implementation on the Kensington Mine Project. The technique assumes a log-normal distribution of analytical values to compute percentile distributions.

F. GROUND WATER QUALITY

F. GROUND WATER QUALITY

GROUND WATER QUALITY AND MONITORING

A program to characterize the existing ground water quality in the project area was established at the Kensington mine site in 1989. Wells were installed throughout the Sherman Creek basin and the Terrace Area basin to sample ground waters. Results of the ground water monitoring program through October 1995 are presented in Montgomery Watson (1996c); data through June 1996 are presented in Montgomery Watson (1996b). Ground water quality data collected from the Terrace Area drainage basin (proposed dry tailings facility [DTF] site) are provided in SRK 1996e. More detailed discussion of the ground water monitoring program can be found in Montgomery Watson (1996a; 1996c) and in the *Technical Resource Document for Water Resources, Kensington Mine Project* (SAIC, 1997).

The locations of the ground water monitoring wells installed in the Sherman Creek drainage basin are shown in Figure F-1 and their characteristics are summarized in Table F-1. Most wells were sampled on a monthly or quarterly basis during their period of record, which ranges from 16 months (SH-8) to 7 years (SH-3).

The locations of the ground water monitoring wells installed in the Terrace Area drainage basin are shown on Figure F-2 and their characteristics are summarized in Table F-1. Three additional wells (i.e., MW 96-6A, MW 96-8A, MW 96-9) were completed in the Terrace Area, but water quality data have not been reported for these wells. The wells in the Terrace Area drainage were sampled once during the summer of 1996.

Ground water samples were collected by Kensington Joint Venture staff prior to December 1995 and have been collected by Montgomery Labs personnel since that time. Portable equipment was used to measure pH, turbidity, water temperature, and specific conductance in the field. Samples were filtered in the field through elements with pore diameters of 0.45 mm to prepare them for analysis of dissolved constituents. From 1987 to 1993, field-cleaned, reusable filters were used to process samples; since 1993, single-use, disposable filters have been used. Piezometers were installed in the Sherman Creek drainage boreholes to permit monitoring of ground water levels and quality. Table F-1 borehole depths and sampling intervals. It should be noted that four wells in the Sherman Creek basin (i.e., SH-7, SH-8, SH-10, and SH-11A) were contaminated by grout during installation.

Two laboratories have analyzed samples collected for ground water quality. Intermountain Laboratories (IML) in Sheridan, Wyoming, conducted chemical analyses from 1987 to November 1994. Montgomery Laboratories (ML) in Juneau, Alaska, conducted sample analyses from June 1993 to present. Duplicate ground water samples were not analyzed in the two labs during their period of overlap. However, a program to assess inter-lab consistency, conducted as part of the surface water quality monitoring program, produced reasonably consistent results for the five constituents (i.e., As, Cu, Pb, Hg, and hardness) analyzed by both labs.

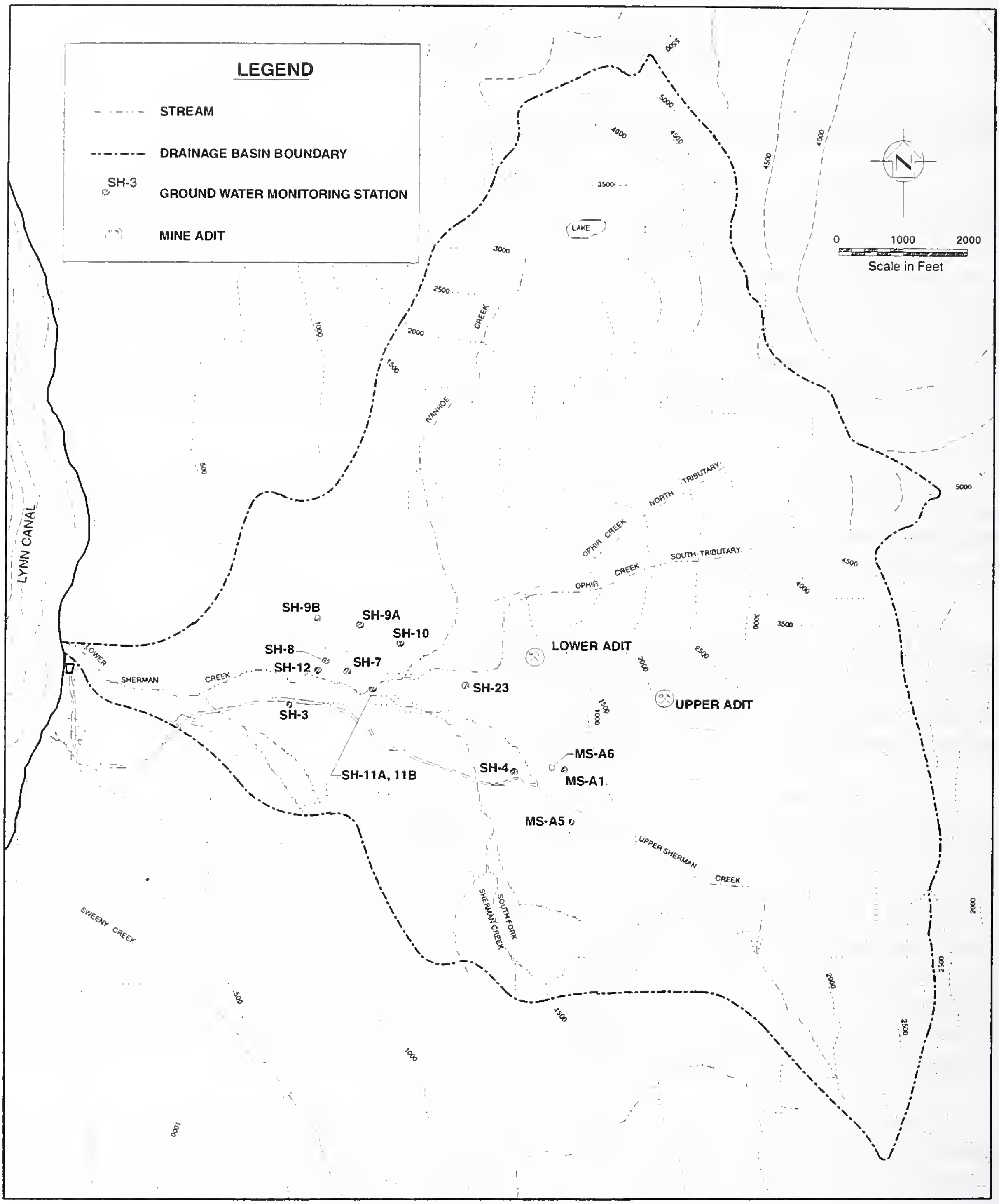


Figure F-1. Ground Water Monitoring Wells in Sherman Creek Drainage Basin (Source: Adapted from Montgomery Watson, 1996 and SRK, 1996d)

214D-44

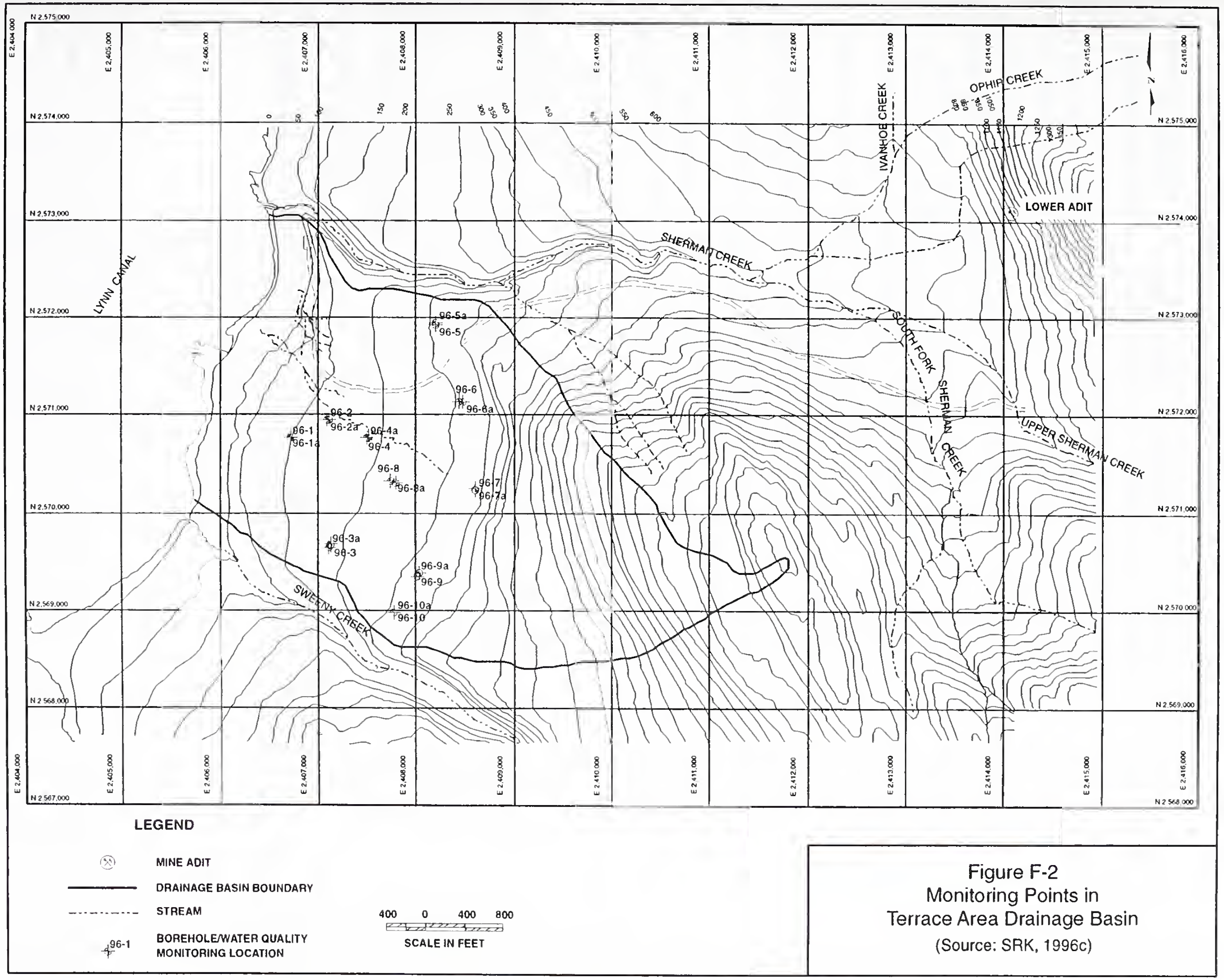


Figure F-2
Monitoring Points in
Terrace Area Drainage Basin
(Source: SRK, 1996c)

214D-52

Table F-1. Ground Water Quality Monitoring Stations

Well Number	Installation Date	Boring Depth[1]	Perforated Interval[1]	Mean-Static Water Depth[1]	Medium of Perforated Interval
			Sherman Creek Drainage Basin[2]		
SH-3	11/6/88	101.5	60-90	54.0	sandy gravelly clay
SH-4	11/7/88	26.0	9.5-24.5	18.0	gravelly sand
SH-7	10/22/89	78.1	44.2-54.2	38.0	phyllite/meta-siltstone
SH-8	8/16/89	110.4	85-95	39.2	clay; phyllite
SH-9A	9/9/89	31.2	21-31	2.2	clayey sand; silty gravel
SH-9B	11/26/89	178.6	134.5-164.5	36.3	clay; clayey sand
SH-10	9/7/89	102.0	67-87	6.2	silty sand; silty gravel
SH-11A	10/30/89	76.3	39.6-46.6	5.6	phyllite
SH-11B	10/31/89	32.0	19-29	6.9	silty sand
SH-12	10/25/89	55.0	21.5-31.5	2.8	phyllite with clay gouge
SH-23	12/15/89	88.5	43-63	n.r.	clay
MS-A1	11/28/90	32.0	16.5-26.5	16.3	silty sand; clay till
MS-A5	11/20/90	40.0	28-38	2.2	clay till
MS-A6	11/29/90	22.5	12.5-22.5	0.0	diorite
			Terrace Area Drainage Basin[3]		
MW 96-1	6/2/96	65.0	42.7-62.7	13.8	slate/phyllite
MW 96-1A	6/3/96	7.1	1.8-6.8	2.0	clayey sand; slate
MW 96-2	6/4/96	63.8	53.5-63.5	13.6	slate
MW 96-2A	6/3/96	7.1	1.8-6.8	2.6	silty sand; slate
MW 96-3	5/31/96	78.4	66.4-76.4	5.4	slate/phyllite
MW 96-3A	5/31/96	7.0	1.5-6.5	3.6	clayey sand; phyllite
MW 96-4	6/14/96	28.2	22.5-27.5	2.6	slate
MW 96-4A	6/14/96	8.0	1.1-6.0	0.9	peat; silty sand; slate
MW 96-5	6/13/96	44.7	37.0-42.0	11.6	phyllite
MW 96-5A	6/13/96	8.5	3.0-8.0	2.2	slate/phyllite
MW 96-6	6/12/96	15.3	9.8-14.8	2.7	slate
MW 96-7	6/11/96	39.0	22.7-37.7	1.8	slate/phyllite
MW 96-7A	6/10/96	9.6	4.2-9.2	1.7	silty sand/gravel; slate
MW 96-8	6/9/96	33.8	n.r.	n.r.	clayey sand/gravel
MW 96-9A	6/7/96	7.3	2.0-7.0	1.2	silty sand/gravel; slate
MW 96-10	6/6/96	44.1	27.2-42.2	2.3	slate
MW 96-10A	6/5/96	8.5	1.1-6.1	1.3	peat; silty sand; slate

1. Depths given in feet; mean static water table as feet below top of casing.
   n.r. = not reported.
2. Data are from Montgomery Watson, 1996a.
3. Data are from SRK, 1996f. Perforated interval is interval of slotted pvc.

Laboratory work was performed in accordance with 40 CFR Part 136, *Guidelines Establishing Test Procedures for the Analysis of Pollutants* and EPA *Methods for Chemical Analysis of Water and Wastes*. As a check on analytical accuracy, both labs routinely performed analyses of blanks and synthesized standards of known composition; sample analyses were corrected accordingly as required by EPA quality assurance/quality control procedures. Table F-2 lists the analytical methods and reporting limits of both labs. Note that analytical methods have improved with time, showing a general trend toward lower reporting limits.

Table F-2. Laboratory Methods, Reporting Limits, and Reporting Periods

Parameter	Intermountain Laboratories			Montgomery Laboratories		
	Analysis Method	Analysis Period	Reporting Limit	Analysis Method	Analysis Period	Reporting Limit
Aluminum (µg/l)	EPA 200.7	06/88-11/94	100	EPA 202.1	07/93-11/95	500
Arsenic (µg/l)	EPA 206.2	09/87-11/94	5	EPA 200.9	07/93-09/93	5
	---	---	---	EPA 206.2	10/93-10/95	0.5
Barium (µg/l)	EPA 200.7	06/88-11/94	500	EPA 208.1	07/93-10/95	500
Cadmium (µg/l)	EPA 213.2	09/87	0.5	EPA 200.9	07/93-09/94	1
	EPA 213.2	10/87-09/91	2	EPA 213.2	10/94-10/95	0.2
	EPA 213.2	10/91-11-94	0.5	---	---	---
Chromium (µg/l)	EPA 200.7	09/87	1	EPA 218.1	07/93-02/95	50
	EPA 200.7	10/87-06/89	5	EPA 218.1	03/95-10/95	20
	EPA 200.7	10/87-09/91	20	---	---	---
	EPA 200.7	10/91-11/94	10	---	---	---
Copper (µg/l)	EPA 200.7	09/87-06/89	2	EPA 200.9	07/93-09/94	20
	EPA 200.7	06/88-09/91	10	EPA 220.1	10/94-10/95	2
	EPA 200.7	10/91-11/94	5	---	---	---
Iron (µg/l)	EPA 200.7	09/87-11/88	10	EPA 236.1	07/93-03/95	100
	EPA 200.7	12/88-11/94	50	EPA 236.1	02/95-10/95	50
Lead (µg/l)	EPA 239.2	09/87	2	EPA 200.9 &	07/93-10/95	2
	EPA 239.2	10/87-11/88	10	239.2	---	---
	EPA 239.2	12/88-09/91	20	---	---	---
	EPA 239.2	10/91-11/94	1	---	---	---
Manganese (µg/l)	EPA 200.7	07/87-06/89	2	EPA 243.1	07/93-02/95	20
	EPA 200.7	06/88-11/94	20	EPA 243.1	03/95-10/95	15
Mercury (µg/l)	EPA 245.1	09/87-09/91	1	EPA 245.2	07/93-09/94	2
	EPA 245.1	11/91-11/94	0.1	EPA 245.2	10/94-10/95	0.2
Molybdenum (µg/l)	EPA 200.7	12/88-11/94	20	EPA 246.1	07/93-10/95	500
Nickel (µg/l)	EPA 200.7	09/87	2	EPA 200.9	07/93-02/95	20
	EPA 200.7	10/87-11/94	10	EPA 249.2	03/95-10/95	10
Selenium (µg/l)	EPA 270.2	09/87	2	EPA 200.9 &	07/93-10/95	5
	EPA 270.2	10/87-11/94	5	270.2	---	---
Silver (µg/l)	EPA 200.7	09/87	1	EPA 200.9	07/93-09/94	50
	EPA 200.7	10/87-11/87	2	EPA 272.1	10/94-10/95	0.5
	EPA 200.7	12/88-09/91	10	---	---	---
	EPA 200.7	10/91-11/94	0.1	---	---	---
Zinc (µg/l)	EPA 200.7	09/87-06/89	2	EPA 289.1	07/93-02/95	20
	EPA 200.7	06/88-11/94	10	EPA 289.1	03/95-10/95	10
Cyanide, free (µg/l)	EPA 335.3	12/89-10/90	5		No Analysis	
Cyanide, WAD (µg/l)	EPA 335.3	12/89-10/90	5		No Analysis	
Cyanide, total (µg/l)	EPA 335.3	12/89-10/90	5		No Analysis	
Ortho-Phosphate (µg/l)	EPA 365.1	09/87-06/89	5	EPA 365.1	07/93-10/95	50
	EPA 365.1	09/88-11/94	10	---	---	---
Nitrite-Nitrogen (µg/l)	EPA 300.0	09/87-06/89	5	EPA 354.1	07/93-03/94	100
	EPA 300.0	06/88-11/94	10	EPA 300.0	04/94-09/95	200
	---	---	---	EPA 300.0	10/95	100

Table F-2. Laboratory Methods, Reporting Limits, and Reporting Periods (continued)

Parameter	Intermountain Laboratories Analysis Method	Intermountain Laboratories Analysis Period	Intermountain Laboratories Reporting Limit	Montgomery Laboratories Analysis Method	Montgomery Laboratories Analysis Period	Montgomery Laboratories Reporting Limit
Nitrate-Nitrogen (µg/l)	EPA 353.1	09/87-06/89	200	EPA 353.2,3	07/93-03/94	100
	EPA 353.1	06/88-11/94	10	EPA 353.2,3	04/94-09/95	200
	---	---	---	EPA 353.2,3	10/95	100
Nitrite+Nitrate Nitrogen (µg/l)	EPA 353.2	06/88-11/94	10	ML/EPA 353.2	07/93-08/94	300
	---	---	---	EPA 300.0	09/94-09/95	400
	---	---	---	EPA 353.2	10/95	200
Ammonium Nitrogen (µg/l)	EPA 350.1	09/87-01/89	50	ML/EPA 350.1	07/93-09/95	50
	EPA 350.1	06/88-11/93	10	---	---	---
	EPA 350.1	01/94-11/94	50	---	---	---
Boron (mg/l)	EPA 200.7	01/88-11/94	0.01	ML 6010, 200.7	07/93-10/95	0.05
	---	---	---	EPA 212.3	11/93-10/95	0.05
Sodium (mg/l)	SM 325B	12/88-11/94	0.2	EPA 273.1	07/93-10/95	1.0
Potassium (mg/l)	SM 322B	05/89	0.1	EPA 258.1	07/93-10/95	1.0
	SM 322B	09/88-05/94	0.2	---	---	---
Calcium (mg/l)	EPA 215.2	08/88-11/94	1.0	EPA 215.1	07/93-11/93	1.0
	---	---	---	EPA 215.1	12/93-10/95	1.0 to 2.0
Magnesium (mg/l)	SM 318C	09/88-11/94	1.0	EPA 242.1	07/93-10/95	1.0
Fluoride (mg/l)	EPA 340.2	09/88-11/94	0.2	SM 4500-FC	07/93-10/95	0.1
Chloride (mg/l)	EPA 325.3	12/89-11/94	1.0	EPA 325.3	07/93-03/94	1.0
	---	---	---	EPA 300.0	04/94-09/95	2.0
	---	---	---	EPA 300.0	10/95	1.0
Sulfate (mg/l)	EPA 375.3	09/87-11/94	1.0	EPA 300.0	07/93-11/93	2.0
	---	---	---	EPA 300.0	12/93-09/95	4.0
	---	---	---	EPA 300.0	10/95	2.0
Hydroxide (mg/l)	EPA 310.1	10/90-11/94	1.0	EPA 310.1	07/93-10/95	0.001
Carbonate (mg/l)	EPA 310.1	12/88-11/94	1.0	EPA 310.1	07/93-10/95	0.001
Bicarbonate (mg/l)	EPA 310.1	12/88-11/94	1.0	EPA 310.1	07/93-10/95	0.001
Total Alkalinity (mg/l)	EPA 310.1	12/88-11/94	1.0	EPA 310.1	07/93-10/95	2.0
Acidity (mg/l)	EPA 305.1	12/88-11/94	1.0	EPA 305.1	07/93-12/94	2.0
	---	---	---	EPA 305.1	01/95-10/95	10
Hardness (mg/l)	EPA 130.2	12/88-11/94	1.0	ML/SM 2340B	07/93-10/95	1.0
pH (s.u.)	EPA 150.1	09/87-11/94	0.1	EPA 150.1	07/93-10/95	0.001
TDS (mg/l)	EPA 160.1	06/88-11/94	1.0	ML/EPA 160.1	07/93-08/94	10
	---	---	---	ML/EPA 160.1	09/94-10/95	20
Conductivity (µmhos/cm)	EPA 120.1	09/87-11/94	1.0	EPA 120.1	07/93-10/95	4.0
TSS (mg/l)	EPA 160.2	09/88-11/94	1.0	EPA 160.2	07/93-10/95	4.0
Turbidity (NTU)	EPA 180.1	08/88-11/94	0.05	EPA 180.1	07/93-10/95	0.05
Sett. Solids (ml/l)	EPA 160.5	12/88-11/94	0.1	EPA 160.5	07/93-10/95	0.1
SAR (units)	Calculated	12/88-11/94	NA	Calculated	07/93-05/94	0.0000
	---	---	---	Calculated	06/94-10/95	0.0001

The water quality monitoring effort focused primarily on trace metals, which typically occur in concentrations at or near their method detection limits. Nitric and hydrochloric acid digestion of samples was used for analyses of total recoverable metals. Raw analytical data show that dissolved metals concentrations are occasionally reported at levels higher than total metals concentrations. This is particularly true of samples collected during 1993. Montgomery Watson (1996a) discusses this apparent inconsistency, which could result from sample contamination, inappropriate analytical procedures, or overlapping analytical tolerances. While some inconsistent analyses are likely due to overlapping analytical tolerances at concentrations near the method detection limits, the switch from reusable to disposable filters in 1993 corresponded to the near elimination of inconsistent analyses.

Table F-3 summarizes sample analyses conducted through October 1995 for each ground water monitoring station in the Sherman Creek basin. Analytical data were screened and evaluated prior to their inclusion into Table F-3. Duplicate analyses were evaluated using a protocol that gave priority to detected values with the lowest reporting limit. Analyses with inconsistent values between dissolved and total metals were screened using maximum tolerance limits. Thirteen analyses with values outside of their computed tolerance limits were removed from the data base. Seven hundred and eighty-one outlier data points were identified in the Sherman Creek ground water quality data base by computing two standard deviations around the mean value of each constituent. Four of these data points were identified as erroneous and removed from the data base. They included total arsenic analyses of samples collected from stations SH-3 and SH-7 on 9/15/94, which were prepared improperly for analysis; a spurious TDS analysis of a sample collected from station SH-11B on 6/21/94 caused by matrix interference from abnormally high TSS; and a TDS analysis of a sample collected from station SH-11B on 10/9/95 that was contaminated when particles broke through a lab filter. Several values recorded as zero were also eliminated from the data base. These included 25 ground water temperature measurements and zero values recorded for hydroxide, bicarbonate, carbonate and alkalinity at station SH-23 on 2/18/91.

The data presented in Table F-3 were analyzed using a statistical method that utilizes a distribution/substitution technique developed for data with a large number of non-detect values and multiple detection limits. EPA Region 10 and ADEC accepted the method, which was developed by Helsel and Cohn (1988) and Helsel (1990), for implementation on the Kensington Mine Project. The technique assumes a log-normal distribution of analytical values to compute percentile distributions.

Table F-4 presents ground water analyses of samples collected from the Terrace Area drainage basin. The summarized values include analyses of a single sample collected from each of the 17 monitoring wells shown in Table F-1. These data were not analyzed using the robust statistical methods applied to the Sherman Creek drainage data. Instead, non-detected values were included in the statistical computations by using a value of one-half of the method detection limit (MDL); for constituents with variable detection limits (e.g., total Al), a value of one-half of the lowest detection limit (e.g., 0.25 for total Al) was used. Because the data in Tables F-3 and F-4 received different statistical treatment, readers should exercise caution when comparing summarized data from the Sherman Creek and Terrace Area drainages.

Table F-3. Summary of Ground Water Data from the Sherman Creek Drainage

		Al (mg/l)		As (mg/l)		Ba (mg/l)		Cd (mg/l)		Cr (mg/l)		Cu (mg/l)		Fe (mg/l)	
Station[1]		Tot.	Diss.	Tot.	Diss.	Tot.	Diss.	Tot.	Diss.	Tot.	Diss.	Tot.	Diss.	Tot.	Diss.
Station SH-3	Mean	6,785	NA	10	4.2	162	NA	0.64	NA	14	NA	82	3.5	17,128	30
	Min	300	*<100*	5	3	500	*<500*	0.22	*<0.2*	10	*<10*	10	8	280	50
8/89-pres.	Max	59,000	*<500*	36	19	1,200	*<500*	2	*<2*	150	*<50*	880	20.5	160,000	220
m/q	90th	22,600	NA	28	7.0	512	NA	1.5	NA	42	NA	224	8.2	43,800	82
	95th	29,300	NA	32	8.1	750	NA	1.6	NA	82	NA	466	11	85,300	112
	Detects	36	3	24	9	4	0	12	0	10	0	31	4	36	6
	Non-detects	1	35	13	29	33	38	25	38	27	38	6	34	1	31
Station SH-4	Mean	104,990	28	323	NA	538	NA	11	NA	183	NA	1,244	NA	195,690	NA
	Min	1,500	100	13	*<1*	500	*<500*	0.7	*<0.5*	20	*<10*	10	*<5*	2,230	*<50*
11/89-pres.	Max	1,490,000	200	2,900	*7*	7,400	*<500*	300	*15*	2,480	*<50*	16,200	*<20*	2,890,000	*160*
m/q	90th	149,800	100	806	NA	800	NA	5.2	NA	314	NA	1,820	NA	297,400	NA
	95th	914,000	150	2,180	NA	4,220	NA	124	NA	1,412	NA	10,380	NA	1,648,000	NA
	Detects	30	3	29	1	10	0	11	1	21	0	30	1	30	2
	Non-detects	1	28	2	30	21	31	20	30	10	31	1	30	1	29
Station SH-7	Mean	7,091	492	NA	NA	398	NA	NA	NA	31	26	44	8.3	9,802	NA
	Min	500	200	<5	*<5*	700	*<500*	*<0.5*	*<0.5*	10	40	8	5	50	*<50*
11/89-9/94	Max	36,000	1,000	8	*32*	1,300	*1,200*	*32*	<2	100	90	150	16	70,000	*320*
irr.	90th	30,630	1,000	NA	NA	1,141	NA	NA	NA	97	81	147	15	55,144	NA
	95th	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Detects	11	8	1	0	3	2	2	0	6	3	10	7	11	2
	Non-detects	1	4	10	11	9	10	10	12	6	9	2	5	1	10
Station SH-8	Mean	759	492	NA	NA	NA	NA	NA	NA	NA	NA	7.0	NA	551	NA
	Min	400	300	<5	<5	*<500*	*<500*	<2	<2	*<20*	*<20*	10	*<10*	120	*<50*
3/90-6/91	Max	1,800	700	<5	<5	*<500*	*<500*	<2	<2	*<20*	*<20*	20	*10*	2,950	*80*
m	90th	1,345	630	NA	NA	NA	NA	NA	NA	NA	NA	20	NA	2,043	NA
	95th	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Detects	16	15	0	0	0	0	0	0	0	0	5	1	14	1
	Non-detects	0	1	16	16	16	16	16	16	16	16	11	15	2	15
Station SH-9A	Mean	5,563	61	6.4	3.7	NA	NA	NA	NA	21	NA	127	5.1	11,129	679
	Min	100	100	5	3.3	*<500*	*<500*	*<0.5*	*<0.5*	20	*<10*	5	6	460	60
11/89-9/94	Max	43,000	700	18	8	*500*	*<500*	<2	<2	180	*<50*	580	22	74,100	1,540
m/q	90th	14,540	120	13	6.1	NA	NA	NA	NA	56	NA	423	10	27,660	1,470
	95th	34,560	500	17	7.5	NA	NA	NA	NA	140	NA	538	17	60,420	1,528
	Detects	25	6	14	5	1	0	1	0	8	0	24	6	27	23
	Non-detects	2	21	13	22	26	27	26	27	19	27	3	21	0	4
Station SH-9B	Mean	936	NA	16	10	NA	NA	0.52	NA	NA	NA	21	5.0	1,979	112
	Min	100	*<100*	7	6	*<500*	*<500*	0.7	*<0.5*	*<10*	*<10*	9	8	50	230
4/90-9/94	Max	7,900	*<500*	52	24	*<500*	*<500*	1.4	*<2*	*<50*	*<50*	110	15	17,000	1,250
m/q	90th	2,440	NA	28	14	NA	NA	1.3	NA	NA	NA	63	10	4,873	313
	95th	7,630	NA	48	20	NA	NA	NA	NA	NA	NA	101	13	15,200	1,164
	Detects	17	5	27	23	0	0	3	1	1	1	14	4	25	4
	Non-detects	11	23	1	5	28	28	25	27	27	27	14	24	3	24
Station SH-10	Mean	421	105	6.6	5.2	NA	NA	NA	NA	NA	NA	8.9	NA	699	22
	Min	100	100	5	4.4	*<500*	*<500*	*<0.5*	*<0.5*	*<10*	*<10*	7	*<5*	55	50
11/89-9/94	Max	1,400	300	10.5	10.5	*<500*	*<500*	<2	*<2*	*<50*	*<50*	25	*<20*	3,500	140
m/q	90th	1,300	290	8.7	8.0	NA	NA	NA	NA	NA	NA	20	NA	1,911	85
	95th	1,385	300	10	10	NA	NA	NA	NA	NA	NA	24	NA	3,263	134
	Detects	20	11	15	10	0	0	0	0	0	0	7	2	19	3
	Non-detects	2	11	7	12	22	22	22	22	22	22	15	20	3	19
Station SH-11A	Mean	315	89	5.2	NA	NA	NA	NA	NA	NA	NA	9.4	3.1	519	50
	Min	100	100	0.51	*<0.5*	*<500*	*<500*	*<0.2*	*<0.2*	*<10*	*<10*	2.2	5	50	80
11/89-pres.	Max	2,200	200	15	*<5*	*<500*	*<500*	*4*	*<2*	*<50*	*<50*	40	20	3,800	110
m/q	90th	810	185	5.8	NA	NA	NA	NA	NA	NA	NA	31	10	1,522	81
	95th	1,915	200	15	NA	NA	NA	NA	NA	NA	NA	36	11	3,078	101
	Detects	29	15	5	1	0	0	3	0	1	1	19	5	37	4
	Non-detects	9	23	33	37	38	38	35	38	37	37	18	32	1	34

Table F-3. Summary of Ground Water Data from the Sherman Creek Drainage (continued)

Station[1]		Pb (mg/l) Tot.	Pb (mg/l) Diss.	Mn (mg/l) Tot.	Mn (mg/l) Diss.	Hg (mg/l) Tot.	Hg (mg/l) Diss.	Ni (mg/l) Tot.	Ni (mg/l) Diss.	Se (mg/l) Tot.	Se (mg/l) Diss.	Ag (mg/l) Tot.	Ag (mg/l) Diss.	Zn (mg/l) Tot.	Zn (mg/l) Diss.
Station SH-3	Mean	17	NA	591	52	NA	NA	14	NA	NA	NA	0.14	NA	248	6.4
	Min	4	*<1*	50	20	*<0.05*	*<0.05*	10	*<10*	*<5*	*<5*	0.1	*<0.1*	30	10
8/89-pres.	Max	250	*<20*	4,500	75	*<1*	*<1*	110	*<20*	*6*	*8*	0.6	*<50*	1,700	140
m/q	90th	24	NA	1,388	70	NA	NA	60	NA	NA	NA	0.42	NA	540	13
	95th	57	NA	3,150	70	NA	NA	69	NA	NA	NA	NA	NA	1,250	48
	Detects	18	2	36	36	0	0	11	2	1	2	7	0	36	5
	Non-detects	19	35	1	2	37	38	26	36	36	36	30	38	1	32
Station SH-4	Mean	37	NA	6,898	53	0.18	NA	167	NA	NA	NA	0.92	NA	502	8.6
	Min	14	*<1*	20	20	0.2	*<0.05*	10	*<10*	*<5*	*<5*	0.3	*<0.1*	20	10
11/89-pres.	Max	280	*<20*	81,300	240	1.3	*<1*	2,480	*<20*	*<5*	*<5*	11	*<50*	6,320	60
m/q	90th	85	NA	9,008	100	0.49	NA	262	NA	NA	NA	1.6	NA	736	28
	95th	172	NA	54,120	192	1.1	NA	1,442	NA	NA	NA	7.0	NA	4,148	47
	Detects	18	1	31	26	4	0	27	2	0	0	8	0	29	11
	Non-detects	13	30	0	5	27	31	4	29	31	31	23	31	2	20
Station SH-7	Mean	31	1.5	205	NA	NA	NA	23	NA	NA	NA	NA	NA	172	8.9
	Min	7	1	20	*<20*	*<0.1*	*<0.1*	10	*<10*	*<5*	*<5*	*<0.1*	*<0.1*	30	10
11/89-9/94	Max	190	3	1,300	*31*	*<1*	*<1*	80	*<20*	*<5*	*<5*	*<50*	*<50*	810	50
irr.	90th	142	NA	1,069	NA	NA	NA	77	NA	NA	NA	NA	NA	756	41
	95th	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Detects	7	3	7	1	0	0	6	0	0	0	0	0	11	4
	Non-detects	5	9	5	11	12	12	6	12	12	12	12	12	1	8
Station SH-8	Mean	NA	NA	8.3	NA	NA	NA	7.7	NA	NA	NA	NA	NA	18	NA
	Min	<20	*<20*	20	*<20*	*<1*	*<1*	10	*<10*	*<5*	*<5*	*<10*	*<0.1*	10	*<10*
3/90-6/91	Max	<20	*<20*	70	*<20*	*<1*	*<1*	20	*<10*	*<5*	*<5*	*10*	*<10*	50	*10*
m	90th	NA	NA	35	NA	NA	NA	13	NA	NA	NA	NA	NA	40	NA
	95th	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Detects	0	0	3	0	1	0	6	0	0	0	1	0	12	3
	Non-detects	16	16	13	16	15	16	10	16	16	16	15	16	4	13
Station SH-9A	Mean	9.6	0.91	757	461	NA	NA	12	NA	NA	NA	0.14	NA	47	NA
	Min	2	1	120	30	*<0.1*	*<0.1*	10	*<10*	*<5*	*<5*	0.1	*<0.1*	10	*<10*
11/89-9/94	Max	52	2	1,980	710	*<1*	*<1*	90	*<20*	*<5*	*<5*	0.4	*<50*	230	*<20*
m/q	90th	23	2.0	1,338	700	NA	NA	32	NA	NA	NA	NA	NA	106	NA
	95th	44	NA	1,736	706	NA	NA	70	NA	NA	NA	NA	NA	206	NA
	Detects	9	4	27	26	0	0	11	0	0	0	4	1	24	10
	Non-detects	17	22	0	1	27	27	16	27	27	27	23	26	3	17
Station SH-9B	Mean	5.8	1.1	174	134	NA	NA	NA	NA	NA	NA	0.13	NA	29	6.0
	Min	1	1	70	30	*<0.05*	*<0.05*	*<10*	*<10*	*<5*	*<5*	0.1	*<0.1*	10	10
4/90-9/94	Max	11.5	3	690	690	*<1*	*<1*	*24*	*<20*	*6.5*	*6*	0.8	*<50*	260	20
m/q	90th	11	2.8	428	132	NA	NA	NA	NA	NA	NA	0.80	NA	78	11
	95th	NA	NA	605	447	NA	NA	NA	NA	NA	NA	NA	NA	188	20
	Detects	10	5	27	27	0	0	2	2	1	1	3	1	19	6
	Non-detects	18	23	1	1	28	28	26	26	27	27	25	27	9	22
Station SH-10	Mean	8.0	NA	24	NA	NA	NA	NA	NA	NA	NA	NA	NA	28	NA
	Min	5	*<1*	20	*<20*	*<0.1*	*<0.1*	*<10*	*<10*	*<5*	*<5*	*<0.1*	*<0.1*	10	*<10*
11/89-9/94	Max	14	*<20*	120	*110*	*<1*	*<1*	*<20*	*<20*	*<5*	*<5*	*<50*	*<50*	92	*<20*
m/q	90th	NA	NA	73	NA	NA	NA	NA	NA	NA	NA	NA	NA	80	NA
	95th	NA	NA	114	NA	NA	NA	NA	NA	NA	NA	NA	NA	90	NA
	Detects	5	2	10	2	0	0	1	0	0	0	2	0	17	2
	Non-detects	17	20	12	20	22	22	21	22	22	22	20	22	5	20
Station SH-11A	Mean	5.7	NA	15	NA	NA	NA	4.8	NA	NA	NA	0.07	NA	22	5.4
	Min	1	*<1*	20	*<15*	*<0.05*	*<0.05*	10	*<10*	*<5*	*<5*	0.1	*<0.1*	10	10
11/89-pres.	Max	67	*<20*	150	*<20*	*<1*	*<1*	100	*<20*	*<5*	*<5*	0.2	*<50*	150	14
m/q	90th	11	NA	53	NA	NA	NA	10	NA	NA	NA	0.18	NA	46	10
	95th	20	NA	93	NA	NA	NA	15	NA	NA	NA	NA	NA	105	12
	Detects	15	3	7	0	0	0	6	3	0	0	4	1	28	4
	Non-detects	22	34	31	38	38	38	32	35	38	38	34	37	9	33

Table F-3. Summary of Ground Water Data from the Sherman Creek Drainage (continued)

Station[1]		CN (free) (mg/l)	CN (WAD) (mg/l)	CN (total) (mg/l)	NO_3-N (mg/l)	NH_4-N (mg/l)	pH (s.u.)	TDS (mg/l)	Cond (mmhos/cm)	TSS (mg/l)	Turbidity (NTU)
Station SH-3	Mean	NA	NA	NA	174	74	7.9	165	283	395	217
	Min	<5	<5	<5	10	10	7.4	123	252	13	4.2
8/89-pres.	Max	<5	<5	7	3,550	530	8.3	200	342	2,600	1,800
m/q	90th	NA	NA	NA	525	145	8.2	183	310	743	335
	95th	NA	NA	NA	947	328	8.3	200	326	2,410	1,705
	Detects	0	0	1	23	26	38	38	38	38	38
	Non-detects	10	10	9	15	8	0	0	0	0	0
Station SH-4	Mean	9.5	32	9.5	593	76	6.3	42	65	5,303	2,122
	Min	10	7	11	40	10	5.7	18	29	358	120
11/89-pres.	Max	35	40	116	5,220	440	6.8	76	171	49,500	14,100
m/q	90th	35	116	35	1,352	282	6.8	64	102	10,058	4,678
	95th	NA	NA	NA	3,300	440	6.8	74	134	29,460	10,800
	Detects	3	6	8	28	18	31	31	31	31	31
	Non-detects	7	4	2	3	13	0	0	0	0	0
Station SH-7	Mean	NA	NA	NA	574	350	12	983	4,304	827	250
	Min	<5	<5	<5	20	120	8.6	332	395	18	8.6
11/89-9/94	Max	<5	<5	7	2,960	910	12.6	2,142	9,500	3,760	1,400
irr.	90th	NA	NA	NA	2,876	830	13	1,948	9,064	3,310	1,037
	95th	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Detects	0	0	1	8	12	13	13	13	12	13
	Non-detects	8	8	7	5	1	0	0	0	0	0
Station SH-8	Mean	NA	NA	NA	208	233	12	758	3,287	38	24
	Min	<5	<5	<5	30	30	11.5	564	1,250	4	3.5
3/90-6/91	Max	<5	8	14	1,020	510	12.4	1,132	5,630	210	125
m	90th	NA	NA	NA	884	426	12	1,114	5,546	112	72
	95th	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Detects	0	1	2	13	16	16	16	16	16	16
	Non-detects	9	8	7	3	0	0	0	0	0	0
Station SH-9A	Mean	NA	NA	NA	94	128	7.6	101	182	411	179
	Min	<5	<5	<5	10	10	6.7	100	127	3	1
11/89-9/94	Max	<5	<5	9	1,320	930	9.2	186	263	3,072	900
m/q	90th	NA	NA	NA	250	334	8.1	125	222	1,376	580
	95th	NA	NA	NA	956	810	8.8	140	259	2,403	820
	Detects	0	0	2	8	20	27	27	27	27	27
	Non-detects	9	9	7	19	7	0	0	0	0	0
Station SH-9B	Mean	NA	NA	NA	48	71	7.8	140	233	42	30
	Min	<5	<5	<5	10	10	6.6	52	55.5	1	0.5
4/90-9/94	Max	<5	<5	<5	850	280	8.3	172	304	300	310
m/q	90th	NA	NA	NA	193	193	8.2	160	266	114	66
	95th	NA	NA	NA	567	253	8.3	167	287	287	283
	Detects	0	0	0	7	19	28	28	28	27	28
	Non-detects	7	7	7	21	9	0	0	0	0	0
Station SH-10	Mean	NA	NA	NA	32	318	10	146	331	24	13
	Min	<5	<5	<5	20	30	8.6	110	159	1	1
11/89-9/94	Max	<5	<5	<5	360	910	11.2	322	700	105	40
m/q	90th	NA	NA	NA	144	613	11	170	514	72	40
	95th	NA	NA	NA	333	874	11	299	675	101	40
	Detects	0	0	0	6	19	22	22	22	22	22
	Non-detects	9	9	9	16	3	0	0	0	0	0
Station SH-11A	Mean	NA	NA	NA	94	160	10	240	497	24	14
	Min	<5	<5	<5	10	10	9.1	0	294	2.5	0
11/89-pres.	Max	<5	<5	<5	870	360	12.2	1,086	3,700	194	100
m/q	90th	NA	NA	NA	313	278	11	238	523	69	34
	95th	NA	NA	NA	775	338	12	371	1,258	88	51
	Detects	0	0	0	19	30	38	37	38	34	37
	Non-detects	11	11	11	19	4	0	0	0	4	0

Table F-3. Summary of Ground Water Data from the Sherman Creek Drainage (continued)

		Al (mg/l)		As (mg/l)		Ba (mg/l)		Cd (mg/l)		Cr (mg/l)		Cu (mg/l)		Fe (mg/l)	
Station[1]		Tot.	Diss.	Tot.	Diss.	Tot.	Diss.	Tot.	Diss.	Tot.	Diss.	Tot.	Diss.	Tot.	Diss.
Station SH-11B	Mean	77,300	1,023	57	30	1,557	NA	1.4	NA	180	NA	521	22	138,790	2,202
	Min	500	100	0.98	13	500	<500	0.6	<0.2	40	<10	6	5	710	62
11/89-pres.	Max	585,000	13,900	360	304	7,000	1,000	9	<2	1,400	<50	2,900	613	990,000	37,200
m/q	90th	225,200	2,100	126	32	3,940	NA	2.8	NA	538	NA	1,320	21	391,600	4,008
	95th	310,500	10,250	189	72	5,560	NA	6.3	NA	734	NA	2,072	156	567,000	20,950
	Detects	35	22	35	34	24	1	12	1	24	2	34	7	36	25
	Non-detects	2	15	2	3	13	36	25	36	13	35	3	30	1	12
Station SH-12	Mean	782	31	7.3	4.8	NA	NA	0.47	NA	NA	NA	9.0	NA	982	29
	Min	100	100	5	4	<500	<500	0.6	<0.5	<10	<10	5	<5	70	50
11/89-9/94	Max	5,300	400	15	13	770	<500	4	<2	<50	<50	30	<20	8,200	310
m/q	90th	4,260	100	14	8.0	NA	NA	0.99	NA	NA	NA	25	NA	3,180	88
	95th	5,180	235	15	10	NA	NA	2.4	NA	NA	NA	29	NA	5,938	219
	Detects	20	4	21	15	2	0	4	0	0	0	13	2	30	6
	Non-detects	11	28	10	17	29	32	27	32	31	32	18	30	1	26
Station SH-23	Mean	161	NA	9.7	8.0	NA	NA	NA	NA	NA	NA	7.5	5.1	624	NA
	Min	200	<100	5	5	<500	<500	<0.5	<0.5	<10	<10	7	10	50	<50
2/90-9/94	Max	800	<500	14	13	<500	<500	<2	<2	<50	<50	32	20	1,440	<100
m/q	90th	470	NA	13	12	NA	NA	NA	NA	NA	NA	27	10	NA	NA
	95th	735	NA	13	12	NA	NA	NA	NA	NA	NA	31	19	NA	NA
	Detects	8	0	28	26	0	0	2	1	0	0	9	4	21	0
	Non-detects	24	32	4	6	32	32	30	31	32	32	23	28	11	32
Station MS-A1	Mean	175,580	NA	269	NA	842	NA	2.9	NA	432	NA	2,358	3.7	331,690	NA
	Min	48,000	<100	9	<5	500	<500	1	<0.5	90	<10	1,020	7	62,800	<50
4/91-3/94	Max	462,000	1,400	550	<5	2,600	<500	20	<2	1,230	<20	5,160	20	890,000	2,600
m/q	90th	398,000	NA	550	NA	1,600	NA	3.1	NA	1,100	NA	5,080	7.0	811,000	NA
	95th	462,000	NA	550	NA	2,600	NA	20	NA	1,230	NA	5,160	20	890,000	NA
	Detects	18	1	18	0	15	0	14	0	18	1	18	3	18	2
	Non-detects	1	18	1	19	4	19	5	19	1	18	1	16	1	17
Station MS-A5	Mean	72,517	NA	218	68	808	NA	9.7	NA	155	NA	482	NA	126,970	1,852
	Min	700	<100	31	26	600	<500	0.31	<0.2	10	<10	10	<2	150	50
3/91-pres.	Max	770,000	12,000	1,700	134	7,000	1,500	94	2.6	1,700	<50	3,700	150	1,405,000	34,700
m/q	90th	280,000	NA	782	134	3,230	NA	40	NA	620	NA	2,400	NA	540,000	340
	95th	770,000	NA	NA	NA	7,000	NA	94	NA	1,700	NA	3,700	NA	1,405,000	34,700
	Detects	18	2	17	17	6	1	9	2	6	2	17	2	18	5
	Non-detects	1	17	1	1	13	18	10	17	13	17	2	17	1	14
Station MS-A6	Mean	75	NA	6.2	5.2	NA	NA	NA	NA	NA	NA	7.0	3.6	518	172
	Min	100	<100	5	4.8	<500	<500	<0.2	<0.2	<10	<10	5	6	280	110
1/91-pres.	Max	600	<500	11	7	<500	<500	<2	<2	<50	<50	30	10	1,390	370
m/q	90th	202	NA	8.9	6.9	NA	NA	NA	NA	NA	NA	20	6.5	853	336
	95th	530	NA	11	7.0	NA	NA	NA	NA	NA	NA	27	9.3	1,302	363
	Detects	6	2	20	11	0	0	0	0	0	0	9	3	25	13
	Non-detects	20	24	6	15	26	26	26	26	26	26	17	23	1	13

Table F-3. Summary of Ground Water Data from the Sherman Creek Drainage (continued)

Station[1]		Pb (mg/l) Tot.	Pb (mg/l) Diss.	Mn (mg/l) Tot.	Mn (mg/l) Diss.	Hg (mg/l) Tot.	Hg (mg/l) Diss.	Ni (mg/l) Tot.	Ni (mg/l) Diss.	Se (mg/l) Tot.	Se (mg/l) Diss.	Ag (mg/l) Tot.	Ag (mg/l) Diss.	Zn (mg/l) Tot.	Zn (mg/l) Diss.
Station SH-11B	Mean	37	5	3,402	101	NA	NA	161	4.7	NA	NA	8.5	NA	464	27
	Min	1	1	20	20	<0.05	<0.05	10	10	<5	<5	0.1	<0.1	10	10
11/89-pres.	Max	250	125	21,000	1,960	<1	<1	1,100	60	<50	<5	300	<50	2,700	800
m/q	90th	100	6.9	8,584	196	NA	NA	450	12	NA	NA	2.0	NA	1,142	20
	95th	124	58	13,800	826	NA	NA	614	42	NA	NA	35	NA	1,935	188
	Detects	23	5	35	14	3	0	29	5	1	0	8	3	35	7
	Non-detects	14	32	2	23	34	37	8	32	36	37	29	34	1	29
Station SH-12	Mean	7.1	1.1	62	33	NA	NA	NA	NA	NA	NA	0.16	NA	29	4.7
	Min	1	1	20	20	<0.05	<0.05	<10	<10	<5	<5	0.1	<0.1	10	10
11/89-9/94	Max	38	2	280	70	<1	<1	<20	<20	<5	<5	1	<50	260	50
m/q	90th	16	2.0	126	50	NA	NA	NA	NA	NA	NA	0.92	NA	58	17
	95th	30	NA	196	57	NA	NA	NA	NA	NA	NA	NA	NA	170	31
	Detects	12	6	31	24	0	0	5	2	0	0	5	1	18	5
	Non-detects	19	26	0	8	31	32	26	30	31	32	26	31	13	27
Station SH-23	Mean	1.5	NA	34	25	NA	NA	NA	NA	NA	NA	0.84	NA	13	5.7
	Min	1	<1	20	20	<0.05	<0.05	<10	<10	<5	<5	0.1	<0.1	10	10
2/90-9/94	Max	9	<20	60	40	<1	<1	<20	<20	<5	<5	10	<50	70	80
m/q	90th	6.9	NA	50	38	NA	NA	NA	NA	NA	NA	1.3	NA	47	10
	95th	NA	NA	60	40	NA	NA	NA	NA	NA	NA	10	NA	67	61
	Detects	7	1	29	29	0	0	1	2	0	0	8	1	14	5
	Non-detects	24	30	3	3	32	32	31	30	32	32	24	31	18	27
Station MS-A1	Mean	291	1.1	6,646	176	0.23	NA	309	NA	NA	NA	30	NA	677	NA
	Min	157	1	180	20	0.2	<0.05	70	<10	<5	<5	0.6	<0.1	10	<10
4/91-3/94	Max	660	6	15,100	1,350	0.6	<1	820	10	9	9	503	<50	1,840	10
m/q	90th	560	5.6	14,600	870	0.60	NA	720	NA	NA	NA	15	NA	1,260	NA
	95th	660	NA	15,100	1,350	NA	NA	820	NA	NA	NA	503	NA	1,840	NA
	Detects	15	4	19	13	5	1	18	1	2	1	10	2	19	6
	Non-detects	4	15	0	6	14	18	1	18	17	18	9	17	0	13
Station MS-A5	Mean	77	4.8	3,474	281	0.17	NA	146	NA	NA	NA	1.7	NA	533	NA
	Min	5.4	1	20	20	0.2	<0.05	10	<10	<5	<5	0.2	<0.1	10	<10
3/91-pres.	Max	690	87	32,000	4,870	1.51	<1	1,600	60	<50	<5	16.4	<50	4,000	150
m/q	90th	260	1.1	15,000	59	1.2	NA	530	NA	NA	NA	8.1	NA	2,700	NA
	95th	690	87	32,000	4,870	1.5	NA	1,600	NA	NA	NA	NA	NA	4,000	NA
	Detects	12	3	19	15	3	0	9	1	0	0	5	2	18	2
	Non-detects	7	16	0	4	16	19	10	18	19	19	14	17	1	17
Station MS-A6	Mean	0.8	NA	198	184	NA	NA	NA	NA	NA	NA	0.06	NA	11	8.1
	Min	1	<1	170	20	0.09	0.09	<10	<10	<5	<5	0.1	<0.1	10	10
1/91-pres.	Max	3	<20	220	220	<1	<1	<20	<20	<5	<5	0.2	<50	40	22
m/q	90th	2.2	NA	220	210	NA	NA	NA	NA	NA	NA	0.18	NA	29	20
	95th	NA	NA	220	217	NA	NA	NA	NA	NA	NA	NA	NA	37	21
	Detects	5	1	26	25	1	1	1	1	0	0	3	1	11	5
	Non-detects	21	25	0	1	25	25	25	25	26	26	23	25	15	21

Table F-3. Summary of Ground Water Data from the Sherman Creek Drainage (continued)

Station[1]		CN (free) (mg/l)	CN (WAD) (mg/l)	CN (total) (mg/l)	NO_3-N (mg/l)	NH_4-N (mg/l)	pH (s.u.)	TDS (mg/l)	Cond (mmhos/cm)	TSS (mg/l)	Turbidity (NTU)
Station SH-11B	Mean	NA	NA	NA	86	486	8.6	395	406	2,388	3,864
	Min	<5	<5	<5	10	60	8	192	302	3	2
11/89-pres.	Max	<5	5	9	780	10,000	12	1,900	995	20,680	37,500
m/q	90th	NA	NA	NA	252	364	8.8	786	432	8,732	10,080
	95th	NA	NA	NA	591	3,350	9.8	1,420	536	15,478	17,250
	Detects	0	1	1	19	30	37	35	37	37	37
	Non-detects	10	9	9	18	3	0	0	0	0	0
Station SH-12	Mean	NA	NA	NA	215	208	8.4	185	299	37	17
	Min	<5	*<5*	*<5*	10	10	7.9	144	263	1	0.4
11/89-9/94	Max	<5	*7*	*18*	2,500	470	9.9	265	344	290	145
m/q	90th	NA	NA	NA	661	368	8.9	205	330	120	46
	95th	NA	NA	NA	1,518	464	9.4	249	338	230	126
	Detects	0	1	2	22	31	32	32	32	32	32
	Non-detects	10	9	8	10	1	0	0	0	0	0
Station SH-23	Mean	NA	NA	NA	67	184	8.3	201	339	8	3.5
	Min	<5	<5	<5	10	30	7.9	0	295	1	0
2/90-9/94	Max	<5	<5	<5	800	670	8.7	244	411	50	24
m/q	90th	NA	NA	NA	225	382	8.6	236	381	30	13
	95th	NA	NA	NA	586	527	8.7	242	392	35	20
	Detects	0	0	0	15	30	32	31	32	23	31
	Non-detects	9	9	9	17	2	0	0	0	9	0
Station MS-A1	Mean	NA	NA	NA	212	149	6.8	81	119	19,603	13,688
	Min	NA	NA	NA	10	10	6.2	52	60	108	270
4/91-3/94	Max	NA	NA	NA	2,160	780	8	156	268	152,000	138,000
m/q	90th	NA	NA	NA	760	400	7.4	118	192	30,210	39,400
	95th	NA	NA	NA	2,160	780	8.0	156	268	152,000	138,000
	Detects	0	0	0	13	16	19	19	19	19	19
	Non-detects	0	0	0	6	3	0	0	0	0	0
Station MS-A5	Mean	NA	NA	NA	158	166	8.0	172	257	5,765	2,812
	Min	NA	NA	NA	10	10	7.6	121	208	23	7.5
3/91-pres.	Max	NA	NA	NA	870	950	8.4	252	305	63,700	22,000
m/q	90th	NA	NA	NA	810	410	8.2	230	285	21,000	16,000
	95th	NA	NA	NA	870	NA	8.4	252	305	63,700	22,000
	Detects	0	0	0	12	14	19	19	19	19	19
	Non-detects	0	0	0	7	4	0	0	0	0	0
Station MS-A6	Mean	NA	NA	NA	121	63	7.8	169	282	3.8	4.1
	Min	NA	NA	NA	10	10	7.5	133	200	1	1.3
1/91-pres.	Max	NA	NA	NA	1,560	200	8.1	190	317	17	9.5
m/q	90th	NA	NA	NA	415	190	8.1	184	300	12	5.5
	95th	NA	NA	NA	1,294	199	8.1	189	311	16	8.1
	Detects	0	0	0	9	15	26	26	26	17	26
	Non-detects	0	0	0	17	7	0	0	0	9	0

Notes: 1 Dates give period of sample collection; sampling frequency given below: m = monthly; q = quarterly; irr. = irregular.
(a) Minimum and maximum detected values are shown for sets with sufficient data for robust statistical analyis.
(b) Italics indicate overall minimum and maximum values (considering non-detects) for sets with insufficient data for robust statistical analysis.
(c) NA - "No Data Available for Analysis" indicates no analyses were conducted for constituent

Table F-4. Summary of Ground Water Data from the Terrace Area Drainage Basin

Element	MDL	unit	Mean[1]	Std. Dev.[1]	Median[1]	Low	High	n>MDL[2]
Boron	0.05	mg/l	0.12	0.08	0.11	<0.05	0.3	14
Calcium	1-20	mg/l	54.3	35.3	48.0	17.6	174	17
Potassium	1	mg/l	4.35	4.69	3.57	<1	21.4	15
Sodium	1.0-5.0	mg/l	26.0	13.7	23.1	10.1	62.5	17
Cation Sum	0.001	meq/l	4.74	2.45	4.28	2.13	13.5	17
Chloride	1-10	mg/l	23.7	13.0	20.8	8.52	50.9	17
Fluoride	0.1	mg/l	0.07	0.05	<0.1	<0.1	0.22	3
Carbonate	0.001	mg/l	0.734	0.808	0.409	0.001	2.52	17
Bicarbonate	0.001	mg/l	189	130	183	24.2	598	17
Nitrite-N	0.1-0.2	mg/l	<0.2					0
Nitrate-N	0.1-0.2	mg/l	0.136		<0.1	<0.1	0.704	2
NO_2+NO_2	0.2	mg/l	0.168		<0.2	<0.2	0.704	2
Hydroxide	0.001	mg/l	0.009	0.010	0.003	<0.001	0.027	14
Orthophos.	0.05	mg/l	1.1	2.0	<0.05	<0.05	6.4	8
Sulfate	2-20	mg/l	9.2	12.7	4.59	<2	51.4	11
Anion Sum	0.001	meq/l	4.0	2.3	3.7	1.4	11.5	17
Anion/Cation	0.001	percent	10.5	11.2	7.05	1.68	46.2	17
pH-lab	0.001	units	7.3	0.8	7.3	5.8	8.2	17
Acidity	10	mg/l	14.3		<10	<10	90	2
Alkalinity	2	mg/l	155	106	150	19.8	490	17
Conductivity	4	umhos/com	370	131	375	145	625	17
Hardness-calc.	1	mg/l	172	107	149	66	548	17
Hardnes-titr.	10	mg/l	146	82	140	30	390	17
SAR	0.0001	units	0.995	0.800	0.830	0.319	3.81	17
Settlable Solids	0.1	mg/l	2	3	1	<0.01	9	11
TDS	20	mg/l	229	79	220	120	430	17
TSS	4	mg/l	1799	4188	110	7	17000	17
Turbidity	0.05	NTU	780	1418	70	4.4	4800	17

1. Mean, standard deviation and median computed using values of one-half MDL for non-detects.
2. Number of analyses greater than the method detection limit (MDL); total analyses = 17.
Source: SRK, 1996f.

Table F-4. Summary of Ground Water Data from the Terrace Area Drainage Basin (continued)

Element[1]	MDL	unit	Mean[2]	Std. Dev.[2]	Median[2]	Low	High	n>MDL[3]
Al-diss.	0.5	mg/l	<0.5					0
Al-total	0.5-1.0	mg/l	29	50	1.6	<0.5	160	11
As-diss.	0.0005	mg/l	0.005	0.003	0.006	<0.0005	0.013	16
As-total	0.0005-0.001	mg/l	0.025	0.027	0.013	0.0015	0.091	17
Ba-diss.	0.5	mg/l	<0.5		<0.5	<0.5	0.75	1
Ba-total	0.5	mg/l	0.39	0.27	<0.5	<0.5	1.1	4
Cd-diss.	0.0002	mg/l	<0.0002		<0.0002	<0.0002	8.2	1
Cd-total	0.0002	mg/l	0.0007	0.0011	0.0003	<0.0002	0.0038	9
Cr-diss.	0.02	mg/l	<0.02					0
Cr-total	0.02	mg/l	0.00	0.10	<0.02	<0.02	0.29	6
Cu-diss.	0.002	mg/l	0.003	0.007	<0.002	<0.002	0.028	3
Cu-total	0.002-0.008	mg/l	0.1360	0.2700	0.0220	<0.002	1.1	13
Fe-diss.	0.05-1.0	mg/l	1.2	1.5	0.28	<0.05	5.2	14
Fe-total	0.05	mg/l	39.7	75.2	3.7	0.26	240	17
Pb-diss.	0.002	mg/l	<0.002		<0.002	<0.002	0.0035	1
Pb-total	0.002	mg/l	0.032	0.048	0.005	<0.002	0.13	13
Mg-total	1-2	mg/l	8.82	6.31	7.00	1.99	27.6	17
Mn-diss.	0.015	mg/l	0.48	0.38	0.46	0.023	1.6	17
Mn-total	0.015	mg/l	1.4	1.7	0.78	0.045	6.2	17
Hg-diss.	0.2	µg/l	<0.2					0
Hg-total	0.2	µg/l	0.18	0.15	<0.2	<0.2	0.5	4
Mo-diss.	0.5	mg/l	<0.5					0
Mo-total	0.5	mg/l	<0.5					0
Ni-diss.	0.01	mg/l	<0.01					0
Ni-total	0.01	mg/l	0.06	0.09	<0.01	<0.01	0.29	6
Se-diss.	0.005	mg/l	<0.005					0
Se-total	0.005	mg/l	<0.005					0
Ag-diss.	0.0005	mg/l	<0.0005					0
Ag-total	0.0005	mg/l	0.0007	0.0010	<0.0005	<0.0005	0.0042	5
Zn-diss.	0.01	mg/l	0.028	0.032	0.018	<0.01	0.14	14
Zn-total	0.01	mg/l	0.19	0.24	0.070	0.011	0.81	17

1. Dissolved and total metal concentrations; dissolved Mg not reported.
2. Mean, standard deviation and median computed using values of one-half MDL for non-detects.
3. Number of analyses greater than the method detection limit (MDL); total analyses = 17.
Data are from Steffen, Roberston, and Kirsten (1996b).

G. SOILS AND PLANT ASSOCIATIONS

This appendix was excerpted from the following document: U.S. Forest Service. 1991. Kensington Gold Project, Draft Environmental Impact Statement.

G. SOILS AND PLANT ASSOCIATIONS

GENERAL SOIL PROPERTIES

The soils of the study area have been strongly influenced by an extensive history of glaciation that has occurred throughout Southeast Alaska. As a result, all of the soils are very young with respect to the normal processes of soils genesis.

On a national scale, the unique feature of the soils in Southeast Alaska is the predominance of organic soils. The dominant soils are Humic Cryorthods. On a regional scale, the soils of the study area are characterized as very porous and friable, and extremely acidic, except in the lowest horizons that overlie calcareous bedrock.

The typical chemical and physical properties of the soils on the Tongass National Forest have been summarized by the Forest Service (1969). Representative data for the major soil types are presented in Table G-1, Chemical and Physical properties of Tongass Area Soils. Management implications for these soils are summarized in Table G-2, Management Interpretations of Tongass Area Soils. This comparison suggests that most soils have a low susceptibility to induced sediment production.

Intensive mapping of all of the soils on the Tongass National Forest was completed during 1990. (See Figure G-1, Soils Map.) The Kensington soils study area is defined as the area between Lynn Canal and Berners Bay and Berners River north to an east west cutoff approximately 2 miles north of Lions Head Mountain. An Order 4 level of soils survey was conducted for this area by the Forest Service (1990). This survey is of sufficient detail to facilitate broad planning decisions. The soils study area encompasses a total of 47 mapping units that have been delineated. A listing of these soil mapping units is presented in Table G-3, Kensington Area Soil Mapping Units. These soil map units contain a total of 43 soil types. (See Table G-4, Soil Type Acreages in the Kensington Study Area). Excluding miscellaneous land types such as rock outcrop, glaciers, and water the study area contains a total of 29,131 acres of taxonomically identifiable soils. Mineral soils account for 61.8 percent of the study area and organic soils account for 29.2 percent of the area. A description of the major soil types present in the study area follows. Further discussion can be found in the Kensington Soils Technical Report (ACZ, 1991).

Soil Sampling

Representative samples of several soil and mine soil materials were collected and analyzed within the Kensington study area in order to characterize the properties of the soils materials. Site-specific sampling and measurements of the soils within the Kensington study area was conducted on numerous sites within potential development areas including Sherman

Table G-1. Chemical and Physical Properties of Tongass Area Soils

Horizon	pH	Carbon (%)	Total N (%)	C/N Ratio	Available P (ppm)	Ext. CEC (meq/100g)	Ext. Ca (meq/100g)	Ext. Mg (meq/100g)	Ext. K (meq/100g)	Ext. Na (meq/100g)	Base Saturation (%)	Free Iron (%)	Bulk Density (g/cc)	Saturation (%)	Physical Properties % 1/3 Bar Moisture	Physical Properties % 15 Bar Moisture
Freely Drained Type F1 Soils at least 10-inches deep																
0	3.6	--	1.50	--	4.5	115	8.1	8.1	0.8	1.5	16	0.11	--	--	--	--
A2	4.;	5.0	0.20	26	3.5	26	1.0	0.8	0.1	0.2	9	1.1	1.02	--	--	14
B21	4.2	9.2	0.49	19	1.7	59	0.6	0.9	0.2	0.9	5	4.5	0.64	--	--	27
B24	4.7	5.3	0.21	25	2.9	30	0.7	0.3	0.2	0.6	7	4.0	0.69	72	47	30
B3	4.9	3.5	0.16	26	2.6	22	0.4	0.2	0.1	0.5	6	3.0	0.64	--	--	22
Freely-Drained Type F2r Soils (McGilvery Soils) 0 to 2 inches to bedrock																
0	3.4	--	0.88	--	--	112	8.4	5.6	1.9	1.8	14	--	0.12	--	31	27
Deep Freely-Drained Type F3a Soils From Sandy Volcanic Ash																
0	3.6	51	0.77	65	--	145	8.0	15	1.0	1.5	--	0.2	0.17	--	--	39
A2	4.1	5.1	0.08	61	--	12	0.3	0.4	0.1	0.1	--	0.3	0.86	--	45	--
B21	4.2	18.1	0.44	41	--	59	0.5	0.4	0.1	0.2	--	1.1	0.37	--	--	44
B22	4.5	17.3	0.34	51	--	27	0.2	0.2	0.1	0.3	--	0.4	0.30	--	77	48
B3	5.5	4.3	0.14	31	--	60	0.3	0.1	0.0	0.1	--	--	0.24	--	81	--
Somewhat Poorly-Drained Soils Over Compact Till Type F4c Soils																
0	3.8	--	1.07	--	42	100	16.3	5.8	2.8	1.5	28	0.1	--	--	--	--
A2	4.8	0.9	0.09	10	0	16	1.0	0.4	0.1	0.1	10	0.1	--	--	--	--
B2	4.8	2.6	0.14	19	2.5	23	1.2	0.4	0.2	0.2	9	0.5	--	--	--	--
B3	5.0	1.7	0.10	17	2.6	22	1.0	0.3	0.1	0.3	8	0.3	--	--	--	--
Poorly Drained Type F5 Soils																
0	3.5	--	0.91	--	--	103	9.3	3.7	1.1	0.8	15	--	--	--	--	--
Alpine Soils Type A1 Soils																
0-7"	5.1	38.8	1.45	23	--	68	0.5	1.9	0.6	0.6	4	6.7	0.35	--	--	76
7-11"	4.6	13.3	0.65	20	--	49	0.2	0.7	0.1	0.2	2	4.1	0.66	--	--	61

N = Nitrogen; C/N = Carbon / Nitrogen; P = Phosphorus; Ext. = Extractable; CEC = Cation Exchange Capacity; Ca = Calcium; Mg = Magnesium; K = Potassium; Na = Sodium

Table G-2. Management Interpretations of Tongass Area Soils

	Susceptibility to Induced Sediment Production	Landslide Hazard	Depth to Seasonal Saturation Level (ft)	Compactibility	Usual Depth to Bedrock (ft)	Usual Road Construction Problems
Alpine Health Soils (A1)	low to moderate	low to moderate	0 - 3	high	2 - 5	cutbank erosion
Alpine Sedge Soils (A2)	very low to low	very low	0	high	2 - 6	wetness, cutbank erosion
Brushy Snowslide Soils (B)	high	moderate	1 - 3	moderate	1 - 6	cutbank failure, avalanches
Tide Influenced Soils	low	very low	0	low	6+	flooding
Deep, freely-drained young alluvial terrace soils (f1t)	moderate	very low	1 - 3	moderate	6+	flooding
Freely-drained soils at least 10-inches deep (F1)	moderate-high	low to high	1 - 3	moderate	1 - 6	cutbank failure, landslides
Freely-drained soils less than 10-inches deep (McGilvery soils)	low	low	1/2 - 3+	low	0 - 1/2	rock
Deep, freely-drained soils (F3)	low	low	3+	moderate	6+	few
Somewhat poorly-drained soils (F4)	low	very low	1/2 - 1	moderate	6+	few
Poorly-drained soils (F5)	low	very low - low	1/2	high	4 - 6+	wetness, cutbank failure
Somewhat poorly-drained soils of high elevations (F6)	low - high	low-high	1/2 - 1	moderate	1/2 - 3	rock, wetness
Poorly-drained organic soils of high elevations (F7)	high	high	0	high	1/2 - 3	rock, wetness
Free drained soils - Sitka spruce (Fx)	variable	variable	2 - 3+	moderate	1/2 - 6+	rock, cutbank failure
Ice	very low	--	--	--	6+	ice
Sphagnum muskeg (M1)	very low	very low	0	high	6+	wetness
Sedge-slope muskeg (M2)	very low - low	low	0	high	4-10+	wetness, cutbank failure
Rock (R)	very low	low	--	low	0	rock
Erosion V-notch Escarpments (V)	very high	very high	variable	moderate	variable	severe cutbank failure, avalanches, landslides

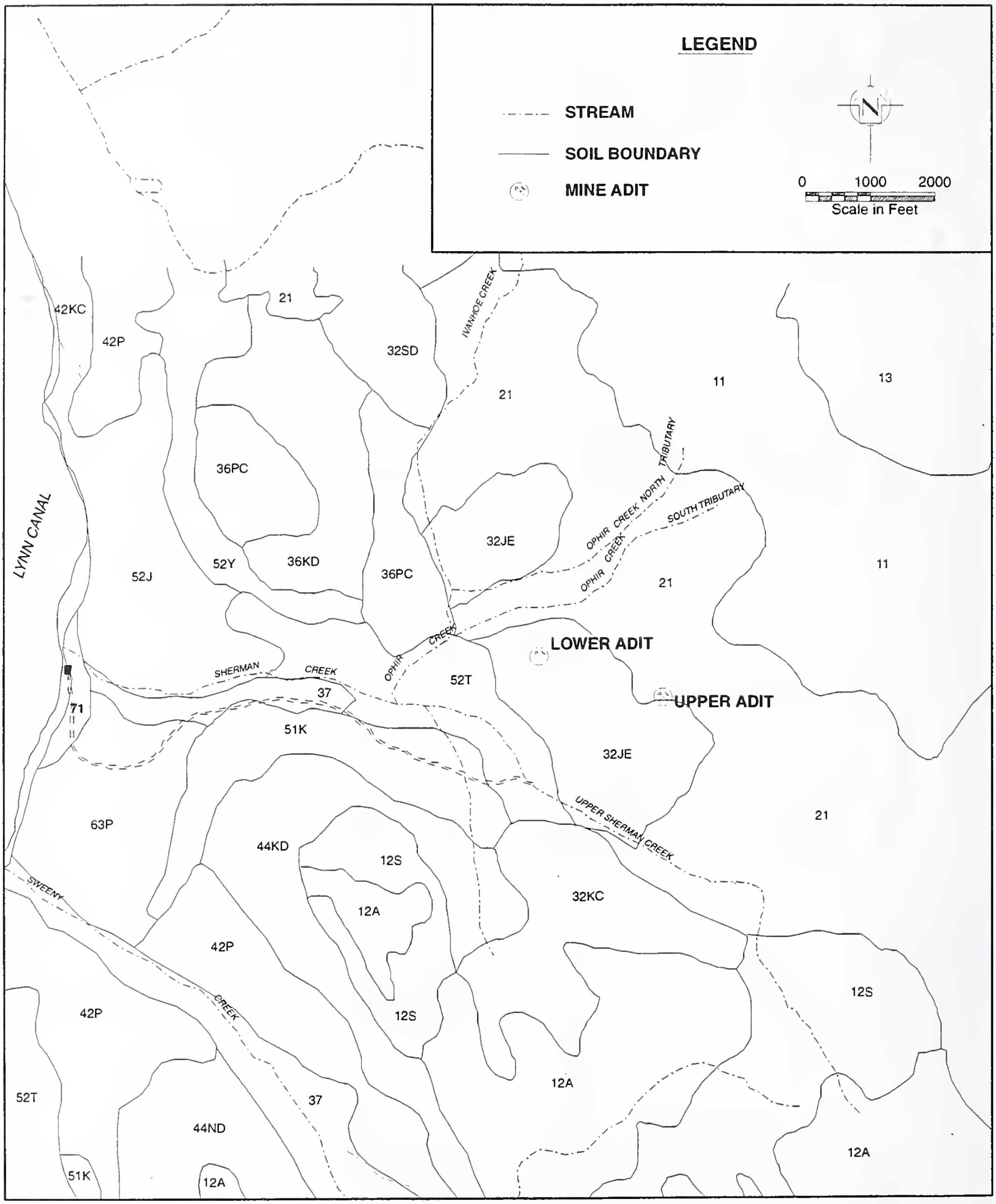


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Figure G-1. Soils Map

Table G-3. Kensington Area Soil Mapping Units

Soil Mapping Unit Key			
11	Rock Outcrop - Lithic Cryorthents	42P	Lithic Cryosaprists - Lithic Cryaquods
12A	Lithic Cryosaprists, Cold - Rock Outcrop	42T	Lithic Cryosaprists
12S	Spodosols, Cold - Lithic Cryosaprist, Cold	44JC	Humic Cryorthods - Typic Cryorthods
13	Glaciers	44JE	Humic Cryorthods - McGilvery
21	Entic Cryumbrepts - Lithic Cryorthents	44KC	Typic Cryaquods - Humic Cryorthods
32JC	Humic Cryorthods - Typic Cryorthods	44KD	Typic Cryaquods - Humic Cryorthods - McGilvery
32JD	Humic Cryorthods - McGilvery 56 to 75 percent slope	44ND	McGilvery - Humic Lithic Cryorthods - Humic Cryorthods
32JE	Humic Cryorthods McGilvery 76 to 120 percent slope	44NE	McGilvery - Humic Lithic Cryorthods
32KC	Typic Cryaquods - Humic Cryorthods	44PC	Lithic Cryaquods - Lithic Cryaquods
32ND	McGilvery - Humic Lithic Cryorthods - Humic Cryorthods	51J	Humic Cryorthods
32SD	Spodosols - McGilvery 56 to 76 percent slope	51K	Humic Cryorthods - Typic Cryaquods
32SE	Spodosols - McGilvery 76 to 140 percent slope	52J	Humic Cryorthods
35JD	Humic Cryorthods - McGilvery	52T	Cryohemists - Typic Cryaquods
35KD	Typic Cryaquods - Humic Cryorthods - McGilvery	52Y	Cryorthods - Cryofluvents
35ND	McGilvery - Humic Lithic Cryorthods - Humic Cryorthods	53M	Cryofibrists
35NE	McGilvery - Humic Lithic Cryorthods	53Y	Cryorthods - Cryofluvents
35SD	Spodosols - McGilvery	61T	Crohemists - Typic Cryaquods
36KD	Typic Cryaquods - Humic Cryorthods	62M	Crohemists
36ND	McGilvery - Humic Lithic Cryorthods - Humic Cryorthods	62T	Crohemists - Cryosaprists
36NE	McGilvery - Humic Lithic Cryorthods	63P	Cryosaprists - Histic Cryaquepts
36PC	Lithic Cryosaprists - Lithic Cryaquods	63T	Cohemists - Typic Cryaquods
36SD	Spodosols - McGilvery	71	Cryaquepts - Typic Cryaquents
37	Entic Cryumbrepts - McGilvery - Rock Outcrop	74E	Typic Cryopsamments - Typic Cryorthods Mixed
42KC	Typic Cryaquods - Humic Cryorthods	W	Fresh Water
42KD	Typic Cryaquods - Humic Cryorthents - McGilvery		

Note: Not all listed soils mapping units exist in the study area, but are shown in the Kensington Soils Technical Report (ACZ Inc., 1991b).

Note: The soil mapping unit key provided with the digitized soil maps lists unit 12A as Lithic Cryorthents, Cold - Rock Outcrop; and 35KD as Typic Cryorthods - McGilvery.

Table G-4. Soil Type Acreages in the Kensington Study Area

Soil Type	Acres
Humic Cryorthods	3,525.4
Lithic Cryosaprists, cold	3,149.6
Typic Cryaquods	2,668.5
Cryohemists	2,475.5
Entic Cryumbrepts	2,322.4
Lithic Cryorthents	1,897.0
McGilvery	1,887.4
Cryofibrists	1,820.1
Lithic Cryorthents	1,728.2
Spodosols	1,408.7
Cryosaprists	989.2
Lithic Cryaquods	920.4
Spodosols, cold	919.2
Humic Lithic Cryorthods	709.7
Sphagnofibrists	630.2
Histic Lithic Cryaquepts	446.0
Histic Cryaquepts	403.4
Typic Cryorthods	334.3
Cryaquepts	175.9
Histisols	174.0
Cryaquods	156.6
Cryofluvents	136.3
Typic Cryaquepts	79.7
Cryorthods	50.0
Typic Cryosaprists	19.1
Cryaquents	45.0
Aquic Cryofluvents	27.8
Typic Eryopsamments	25.1
Cryochrepts	3.2
Hydraquents	3.2

Creek basin, Sweeny Creek basin, and along the proposed Berners Bay access road (Alternative C). Results of these evaluations are presented in Table G-5, Kensington Soil Materials Chemical and Physical Properties. The hazardous waste characteristics of these same samples are summarized in Table G-6, Kensington Soil Materials EP Toxicity Analyses.

Humic Cryorthods

This soil type is the most extensive in the study area covering 3,525 acres or 10.1 percent of the area. It is a component of 20 of the 47 soil map units. This soil is developed on volcanic ash, colluvium, and ablation till parent material; is found on all landscape positions; has a soil drainage class of moderately well to well drained; a permeability class of rapid; and a moderately deep to very deep soil depth. These soils are characterized by well developed mineral horizons and moderately thick (5 to 7 inches) surface organic layers. Soils in this type occupy stable mountain slopes and foot slope intervals which are not associated with disturbance by concentrated surface or subsurface water flow.

Plant associations found on this soil type include the Western Hemlock / Blueberry / Shield Fern, Western Hemlock / Blueberry - Devil's Club, and Western Hemlock / Blueberry habitat types. The most productive Hemlock forests found on the Tongass are supported on these soils.

Lithic Cryosarprists, Cold

This organic soil type covers 3,149.6 acres or 9.1 percent of the study area and is a component of 2 of the 47 soil mapping units. This soil has developed on either mineral or organic material and is typically found on bedrock knobs and on plateaus. It has a drainage class of very poorly drained; a permeability class of moderately slow to moderately rapid; and a soil depth that is generally shallow.

Plant associations found on this soil are Mountain Hemlock / Blueberry Mertens Cassiope and Alpine Shrubland / Emergent Muskeg habitat types.

Typic Cryaquods

This soil type covers 2,668.5 acres or 7.7 percent of the study area and is found as a component of 16 of the 47 soil mapping units. This soil has developed on colluvium, compact till, or ablation till parent materials and is typically found on the lower third of moderately steep slopes. It has a soil drainage class of poorly to somewhat poorly drained; a permeability class of moderately rapid; and has moderately deep to very deep soil depths. These soils are classified as mineral, and on gentler slopes, are deep and somewhat poorly drained. On the steeper slopes soil depth decreases and drainage improves.

Plant associations associated with these soils are the Western Hemlock / Blueberry, Western Hemlock / Blueberry - Devil's Club, and Mixed Conifer / Blueberry habitat types.

Table G-5. Kensington Soil Materials Chemical and Physical Properties

Material	pH	EC (mmhos/cm)	Sat %	Sol. Ca (meg/l)	Sol. Mg (meg/l)	Sol. Na (meg/l)	SAR	Exc. Ca (meg/100g)	Exc. Mg (meg/100g)	Exc. Na (meg/100g)	NO_3-N (mg/kg)	Ext. P (mg/kg)	Ext. K (mg/kg)	Ext. Cu (mg/kg)
Peat	4.8	1.12	136	0.24	0.70	7.33	10.7	2.1	2.64	2.94	-0.1	10.0	280	15.1
Glacial Till	5.2	0.48	70	0.18	0.12	2.85	7.4	0.36	0.53	0.71	-0.1	-0.5	60	9.2
Fresh Ore	7.8	3.46	22	29.70	6.03	8.28	2.0	20.8	0.26	0.26	16.9	1.3	32	1.2
Fresh Waste Rock	8.1	4.14	22	14.13	6.14	20.31	6.4	19.4	0.39	0.63	16.1	-0.5	58	1.3
Weathered Ore	7.8	2.38	21	18.92	5.83	4.61	1.3	22.6	0.27	0.19	16.8	-0.5	23	2.0
Weathered Waste Ore	8.3	1.11	27	6.20	1.93	2.67	1.3	25.0	0.16	0.18	5.4	-0.5	23	2.0
Old Kensingto n Mine Waste Rock	8.0	1.37	20	2.34	1.41	8.23	6.0	19.6	0.44	.40	3.6	-0.5	45	7.7
Old Mill Ore	7.7	1.63	21	9.26	3.76	2.07	0.8	13.3	0.36	0.12	0.1	1.6	51	6.4
Surface Waste Rock Exposure	7.7	.70	23	1.45	0.84	2.96	2.8	1.2	0.10	0.23	-0.2	2.6	43	4.5
Surface Ore Exposure	6.9	1.99	25	21.52	1.33	1.83	0.5	6.1	0.03	0.15	-0.1	2.2	19	0.8
Tailings - 1	7.9	3.65	29	25.5	1.36	5.60	1.5	27.5	0.03	-0.03	0.6	-0.1	70	12.7
Tailings - 2	7.7	3.30	31	21.69	2.47	8.57	2.5	--	--	--	5.0	--	30	8.5
Tailings - 3	7.7	3.24	30	24.53	2.91	10.15	2.7	--	--	--	2.0	--	30	8.9

Exc. = Exchangeable; Mo = Molybdenum; Ni = Nickel; Zn = Zinc; Sol. = Soluble; Se = Selenium; S = Sulfur; Neut. Pot. = Neutralizing Potential; $CaCo_3$ = Calcium Carbonate; ABP = Acid Buffering Potential.
Note: Negative sign (-) denotes less than.

Table G-5. Kensington Soil Materials Chemical and Physical Properties (continued)

Material	Exc. Fe (mg/kg)	Exc. Mn (mg/kg)	Exc. Mo (mg/kg)	Exc. Ni (mg/kg)	Exc. Zn (mg/kg)	Sol. Se (mg/kg)	% Organic S	% Pyrite S	% Sulfate S	% Total S	Neut. Pot. (% $CaCO_3$)	ABP (tons/ 1,000 T)	% Sand	% Silt	% Clay	Texture
Peat	525	11.9	0.5	2.3	35	-0.01	0.06	-0.01	-0.01	0.06	-0.7	-0.9	54	33	14	SL
Glacial Till	548	11.9	0.5	0.6	7.5	0.01	0.02	-0.01	-0.01	0.02	-0.4	-5	73	5	23	SCL
Fresh Ore	34	6.7	-0.5	-0.2	0.4	-0.01	2.07	0.19	-0.01	2.36	4.7	-24	84	11	5	LS
Fresh Waste Rock	53	7.6	-0.5	-0.2	0.7	0.01	0.19	0.04	0.07	0.30	3.9	30	84	10	6	LS
Weathered Ore	35	6.2	-0.5	-0.2	0.3	0.01	0.67	0.22	0.05	0.94	4.6	17	80	15	5	LS
Weathered Waste Ore	51	8.2	-0.5	-0.2	0.4	-0.01	0.11	0.03	0.03	0.17	4.1	36	81	14	5	LS
Old Kensingto n Mine Waste Rock	54	7.3	-0.5	-0.2	1.0	0.02	0.15	-0.01	-0.01	0.15	3.3	28	86	5	9	S
Old Mill Ore	58	13.3	-0.5	-0.2	0.4	0.01	0.63	1.12	0.01	1.75	4.4	-11	86	9	5	S
Surface Waste Rock Exposure	52	11.8	-0.5	-0.2	0.4	-0.01	0.04	0.03	0.01	0.08	0.4	2	83	14	4	LS
Surface Ore Exposure	64	6.4	-0.5	-0.2	0.2	0.02	2.37	0.45	0.68	3.50	0.4	-105	84	13	4	LS
Tailings - 1	88.4	12.0	-0.5	0.5	1.1	-0.03	0.11	0.74	0.12	0.97	9.1	61	39	52	9	SiL
Tailings - 2	89	6.0	-0.5	0.4	0.5	-0.005	0.03	0.64	0.31	0.98	12.3	--	46	44	10	L
Tailings - 3	86	5.4	-0.5	0.5	0.5	-0.005	0.03	0.94	-0.01	0.97	12.8	--	46	45	9	L

Exc. = Exchangeable; Mo = Molybdenum; Ni = Nickel; Zn = Zinc; Sol. = Soluble; Se = Selenium; S = Sulfur; Neut. Pot. = Neutralizing Potential; $CaCo_3$ = Calcium Carbonate; ABP = Acid Buffering Potential.

Note: Negative sign (-) denotes less than.

Table G-6. Kensington Soil Material EP Toxicity Analyses (mg/l)

Material	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Peat	0.002	0.36	-0.005	-0.01	-0.02	-0.0001	0.002	-0.01
Glacial Till	-0.001	0.43	-0.005	-0.01	0.02	-0.0001	-0.002	-0.01
Fresh Ore	0.001	0.21	-0.005	-0.01	-0.02	-0.0001	-0.002	-0.01
Fresh Waste Rock	0.001	0.07	-0.005	-0.01	-0.02	-0.0001	0.002	-0.01
Weathered Ore	0.002	0.47	-0.005	-0.01	-0.02	0.0002	-0.002	-0.01
Weathered Waste Rock	0.001	0.14	-0.005	-0.01	-0.02	-0.0001	-0.002	-0.01
Old Kensington Mine Waste Rock	0.001	0.48	-0.005	-0.01	-0.02	-0.0001	-0.002	-0.01
Old Mill Ore	0.001	0.41	-0.005	-0.01	-0.02	-0.0001	-0.002	-0.01
Surface Waste Rock Exposure	0.002	0.05	-0.005	-0.01	-0.02	-0.0001	-0.002	-0.01
Surface Ore Exposure	0.001	0.16	-0.005	-0.01	-0.02	-0.0001	-0.002	-0.01
Tailings - 1	-0.001	0.57	-0.005	-0.01	0.03	-0.0002	-0.005	-0.01
Tailings - 2	-0.200	0.81	-0.005	-0.01	0.03	-0.0002	-0.02	-0.01
Tailings - 3	-0.200	0.63	-0.005	-0.01	0.03	-0.0002	-0.02	0.03
Suspect Level	≥5.0	≥100.0	≥1.0	≥5.0	≥5.0	≥0.2	≥1.0	≥5.0

Cryohemists

This soil type covers 2,475.5 acres or 7.1 percent of the study area and is found as a component of 7 of the 47 soil mapping units. These soils have developed on organic parent materials, and occupy nearly level sites on gentle slopes or depressions in the lower portions of the mapping unit. They have a soil drainage class of very poorly drained; a permeability class of moderately slow to moderately rapid; and very deep soil depths. These soils are most extensive on lowlands and broad valley bottoms.

Plant associations found on these soils are the Tufted Club Rush / Bog Kalima, Mixed Conifer / Blueberry / Skunk Cabbage, and Mixed Conifer / Blueberry / Deer Cabbage habitat types.

Entic Cryumbrepts

This soil type covers 2,322.4 acres or 6.7 percent of the study area and is found as a component of 12 of the 47 soil mapping units. These soils occupy the lower slopes of the mapping units and have developed largely on colluvium parent materials; they have a soil drainage class of moderately well drained; a permeability class of moderately rapid; and soil depths of moderately deep to deep. These soils occur on floodplains and similar areas with low slope gradients and on steep mountain slopes where the soil is shallow and rock outcrops are common. The soils are mineral and are often disturbed by periodic surface and subsurface water flows. These soils are generally considered to be moderately productive with respect to their timber potential.

Plant associations found on these soils include the Alder-Salmonberry, Alder / Lady Fern, and the Western Hemlock / Blueberry - Devil's Club habitat types.

Lithe Cryosaprists

This soil type covers 1,897 acres or 5.5 percent of the study area and is found as a component of 15 of the 47 soil mapping units. These soils have developed on organic parent materials and occupy all landscape positions on broken mountain slopes and hillsides below the subalpine zone on nearly level sites. They are most extensive on lowlands and broad valley bottoms and commonly occur near sites occupied by muskeg. These soils have a soil drainage class of very poorly drained; a permeability class of moderately rapid; and soil depths of very shallow to moderately deep.

Plant associations found on these soils include the Mixed Conifer / Blueberry / Deer Cabbage, Mixed Conifer / Blueberry, and Mixed Conifer / Blueberry - Copperbush habitat types.

McGilvery

This soil type covers 1,887.4 acres or 5.4 percent of the study area and is the most widespread soil type found in the study. It occurs in 23 of the 47 soil mapping units. These soils occupy shoulder slopes and upper slopes on the mountains at all elevations below the subalpine zone. They typically have a soil drainage class of well drained; a moderately rapid permeability class; soil depths ranging from very shallow to shallow over bedrock; and have developed on organic parent materials.

Plant associations found on these soils include the Western Hemlock / Blueberry, Western Hemlock - Yellow Cedar / Blueberry, and Mixed Conifer / Blueberry habitat types.

Cryofibrists

This soil type covers 1,820.1 acres or 5.2 percent of the study area and is associated with only 2 of the 47 soils mapping units. These soils have developed from organic parent materials and are typically found on areas with very low slope gradients such as in old oxbows and in slack water overflow channels near the river floodplains and terraces. They have a drainage class of very poorly drained; a very rapid permeability class; and soil depths ranging from moderately deep to very deep.

Plant associations with this type include the Alder-Salmonberry, Emergent Tall Sedge Muskeg, and the Emergent Mixed Forb / Grassland habitat types.

Lithic Cryorthents

This soil type covers 1,728.2 acres or 5.0 percent of the study area and is found on 2 of the 47 soils mapping units. These soils have developed on colluvium and residuum parent materials and usually are found on moderately steep to very steep slopes and benches knobs near the rugged mountainous summits. These soils typically have a soil drainage class of moderately

well to well drained; a moderately rapid permeability class; and shallow to very shallow soil depths over bedrock. This type is the most extensive alpine soil type found in Southeast Alaska.

Plant associations associated with these soils include the nonforested Alpine Lichen - Rock Outcrop and Alpine Meadow habitat types.

Spodosols

This soil type covers 1,408.7 acres or 4.1 percent of the study area and is found on 5 of the 47 soils mapping units. These soils have developed on residuum ablation till, and colluvium parent materials and are typically found on all landscape positions from smooth to frequently dissected and shallow incised mountain slopes. They occur at all elevations below the subalpine zone. These soils usually have poorly to well drained drainage classes; moderately rapid permeability; and soil depths ranging from very shallow to deep. These soils are deep and somewhat poorly drained on gentler slopes and become shallower and better drained as the slope gradient increases. This soil type is not disturbed by erosion, flooding, or subsurface groundwater flow.

Plant associations normally found on these soils include the Western Hemlock / Blueberry and Mountain Hemlock / Blueberry / False Hellebore habitat types. These soils are moderately productive with respect to their timber production potential.

PLANT ASSOCIATIONS

The vegetation of southeastern Alaska has been described as a coastal rain forest due to the proliferation of plant growth that occurs in this area. The dominant vegetation type found is a coniferous forest. This type is comprised of several tree species. The most common forest type found in the region is the Coastal Spruce - Hemlock Forest (USFS, 1972). The Forest Service has prepared a Tongass National Forest Type Map which was used as the basis for the vegetation map of the study area (See Figure G-2, Vegetation Map and Table G-7, Kensington Area Vegetation Mapping Units). The plant communities delineated in this mapping effort and associated acreages are presented on Table G-8, Forest Type Acreages in the Kensington Study Area. The following sections present a discussion of specific plant associations within the communities.

Extensive ecological characterization efforts have documented that climax or near climax plant communities possess certain indicator vegetation species that can be used to classify habitat types according to certain soil types. A plant association classification system for the Tongass National Forest has been developed (Martin et al., 1985) which has been correlated to the recent soils mapping information. In the following discussion, plant associations found on 97.6 percent of the study area are described. The remaining 2.4 percent of the area is comprised of eight

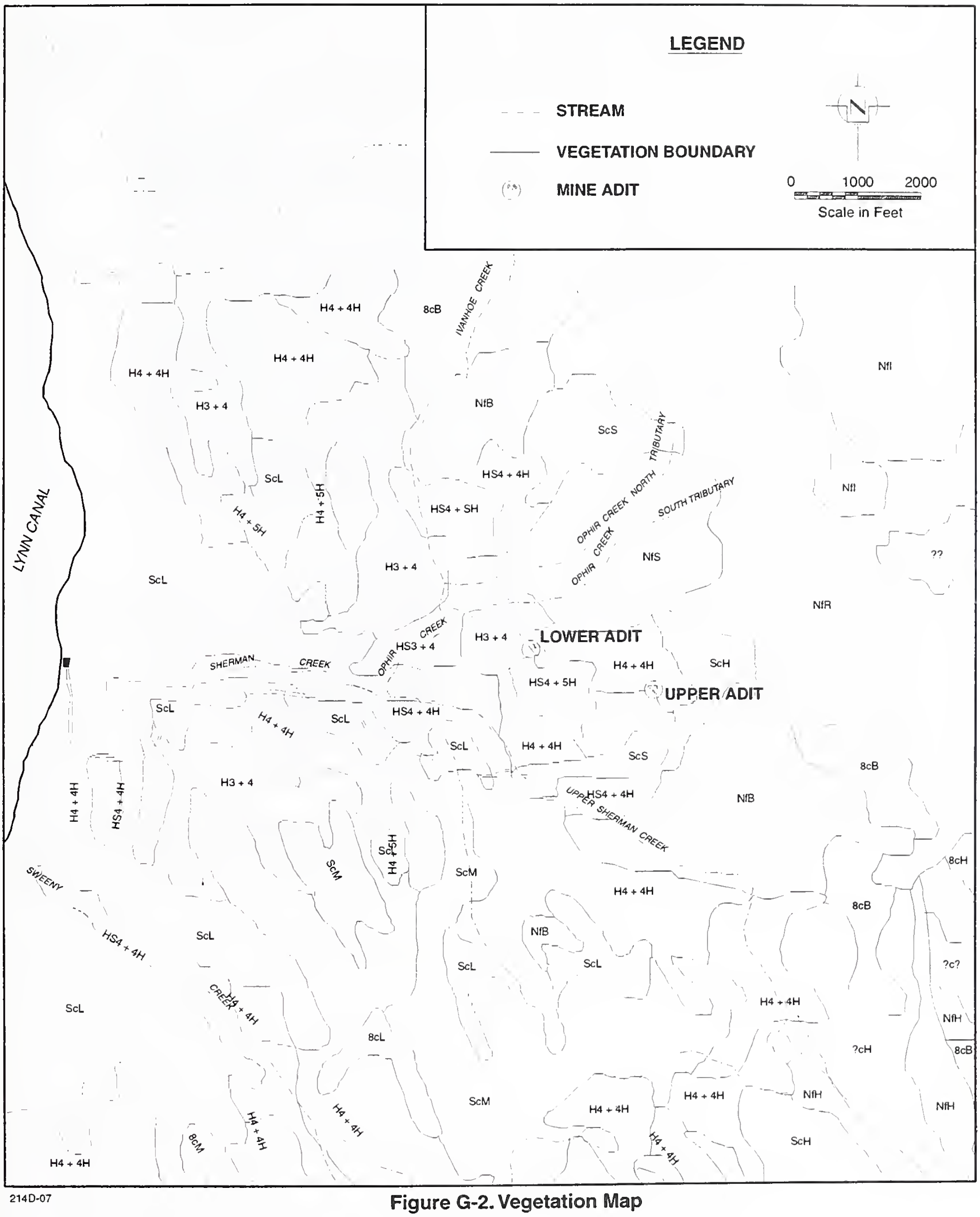

Figure G-2. Vegetation Map

Table G-7. Kensington Area Vegetation Mapping Units

Forest Service Vegetation Mapping Unit Types			
	Hemlock - Spruce		**Spruce (continued)**
H2S +	Poletimber; Well Stocked	S4 = 5H	Old - Growth Sawtimber; Medium Stocking; 8 to 20 MMBD; High Decadence Risk
HS3 + 4	Youth - Growth Sawtimber; Well Stocked; 8 to 20 MMBD	S4 + 6H	Old - Growth Sawtimber; Well Stocked; 8 to 20 MMBD; High Decadence Risk
HS4 = 4H	Old - Growth Sawtimber; Medium Stocking; 8 to 20 MMBD; High Decadence Risk		**Hemlock**
HS4 = 5H	Old - Growth Sawtimber; Medium Stocking; 20 to 30 MMBD; High Decadence Risk	H3 + 4	Young - Growth Sawtimber; Well Stocked; 8 to 20 MMBD
HS4 + 4H	Old - Growth Sawtimber; Well Stocked; 8 to 20 MMBD; High Decadence Risk	H3 = 4H	Old - Growth Sawtimber; Medium/Well Stocked; 8 to 20 MMBD
HS4 + 5H	Old - Growth Sawtimber; Well Stocked; 20 to 30 MMBD; High Decadence Risk	H4 + 4H	Old - Growth Sawtimber; Well Stocked; 8 to 20 MMBD; High Decadence Risk
HS4 + 4L	Old - Growth Sawtimber; Well Stocked; 8 to 30 MMBD; Low Decadence Risk	H4 + 4L	Old - Growth Sawtimber; Well Stocked; 8 to 20 MMBD; Low Decadence Risk
HS4 + 5L	Old - Growth Sawtimber; Well Stocked; 20 to 30 MMBD; Low Decadence Risk	H4 + 5H	Old - Growth Sawtimber; Well Stocked; 20 to 30 MMBD; High Decadence Risk
	Black Cottonwood	H4 + 6H	Old - Growth Sawtimber; Well Stocked; 30 to 50 MMBD; High Decadence Risk
P2 =	Black Cottonwood; Medium Stocking		**Unproductive Forest Classes**
P3 = 4	Black Cottonwood; Medium Stocking; 8 to 20 MMBD	ScR	Rock
P3 = 4H	Black Cottonwood; Medium Stocking; 8 to 20 MMBD; High Decadence Risk	ScL	Low Site
	Spruce	ScM	Muskeg
S2 -	Poletimber; Poorly Stocked	ScH	High Elevation
S2 =	Poletimber; Medium Stocking	ScS	Recurrent Slide Zone
S2 +	Poletimber; Well Stocked		**Nonforest Classes**
S3 = 4	Youth - Growth Sawtimber; Medium Stocking; 8 to 20 MMBD	NfG	Natural Grassland
S3 + 4	Youth - Growth Sawtimber; Well stocked; 8 to 20 MMBD	NfB	Brush (Other Than Alder)
S4 + 4H	Old - Growth Sawtimber; Well Stocked; 8 to 20 MMBD; High Decadence Risk	NfS	Recurrent Snow Slide Zone
S4 + 5H	Old - Growth Sawtimber; Well Stocked; 8 to 20 MMBD; Low Decadence Risk	NfH	Alpine (High Meadow)
		NfR	Rock
		NfI	Ice or Snow Fields
		NfM	Muskeg Meadows

Table G-8. Forest Type Acreage in the Kensington Study Area

Map Symbol	Forest Type	Acres
ScL	Low site	6,530
H4 +4H	Hemlock; old growth sawtimber; well stocked; 8-20 MMBD; high decadence risk	4,883
NfR	Rock	3,696
ScM	Muskeg Forest	2,481
NfI	Ice or smow fields	2,227
HS4 + 4H	Hemlock-spruce; old growth sawtimber; well stocked 8-20 MMBD; high decadence risk	2,037
NfB	Brush (other than alder)	1,658
NfS	Recurrent snow slide zone	1,403
HS4 + 5H	Hemlock-Spruce; old growth sawtimber; medium stocking; 20-30 MMBD; high decadence risk	1,236
ScS	Hemlock-Spruce; old growth sawtimber; medium stocking; 20-20 MMBD; high decadence risk	1,236
H4 + 5H	Hemlock; old growth sawtimber; well stocked; 20-30 MMBD high decadence risk	1,181
NfG	Natural grassland	870
ScH	High elevation (Alpine)	777
NfH	Alpine (high meadow)	683
H4 = H4	Hemlock; old growth sawtimber; medium stocking; 8-20 MMBD	420
HS3 +4	Hemlock-Spruce; young growth sawtimber; well stocked; 8-20 MMBD	398
H3 + 4	Hemlock; young growth sawtimber; well stocked; 8-20 MMBD	373
HS4 + 4L	Hemlock-Spruce; old growth sawtimber; well stocked; 8-20 MMBD; low decadence risk	355
P4 = 4H	Black Cottonwood; medium 8-20 MMBD; high decadence risk	320
HS4 = 4H	Hemlock-Spruce; old growth sawtimber; medium stocked; 8-20 MMBD; high decadence risk	261
W	Water	199
HS4 + 5L	Hemlock-Spruce; old growth sawtimber; well stocked; 20-30 MMBD; low decadence risk	177
ScR	Rock	131
H4 + 4L	Hemlock-Spruce; old growth sawtimber; well stocked; 8-20 MMBD; low decadence risk	129
S3 = 4	Spruce; young growth sawtimber; medium stocking; 8-20 MMBD	109
P3 = 4	Black cottonwood; medium stocking; 8-20 MMBD	87
S4 + 4H	Spruce; old growth sawtimber; well stocked; 8-20 MMBD; high decadence risk	64
S4 + 6H	Spruce; old growth sawtimber; well stocked; 30-50 MMBD; high decadence risk	60
S3 + 4	Spruce; young growth sawtimber; well stocked; 8-20 MMBD	58
HS2 +	Hemlock-Spruce; pole timber; well stocked	47
S2 +	Spruce; pole timber; well stocked	38
NfM	Muskeg Meadow	29
S2 -	Spruce; pole timber; poorly stocked	22
S2 =	Spruce; pole timber; medium stocking	18
P2 =	Black Cottonwood; medium stocking	10

smaller types, three Sitka spruce subtypes, open water, and four small nonforested types. (See Table G-9, Plant Associations in the Kensington Study Area). Table G-10, Forest Plant Associations by Soil Type, correlates study area plant associations with soil mapping units. Table G-11, Kensington Wetlands Functions and Values, provides an evaluation of wetland plant associations based on the system recommended by Adamus Resource Assessment, Inc. (1987b).

Alder - Salmonberry

This nonforested shrubland plant association is the most extensive habitat type within the study area. It covers 4,372 acres or 12.6 percent of the study area and occurs on three soils mapping units. This type is dominated by Sitka alder which generally provide greater than 70 percent cover. Salmonberry, stink currant (*Ribes bracteosum*), and devil's club are common. Dominant understory species are lady fern (*Athyrium filix femina*), oak fern (*Gymnocarpium dryopteris*), twisted stalk (*Streptopus* spp.) and stream violet (*Viola glabella*). This plant community usually occurs on floodplains with low slope gradients. It is considered by the Forest Service to be an upland type but five of the eight dominant plant species have wetland indicator status.

Alpine Shrubland / Emergent Muskeg

This nonforested shrubland plant association is the second most extensive in the study area. It covers 4,354.8 acres or 12.6 percent and occurs on three different soils mapping units. This habitat type occupies areas of poorly drained soils and is dominated by Cassiope (*Cassiope spp.),* yellow mountain heather (*Phyllodoce glandulifera*), and copperbush (*Clodothamnus pryolaeflorus*). The emergent muskeg portion is characterized by sedges. This type is considered to be a wetland plant community.

Western Hemlock / Blueberry

This forested plant association covers 3,212.4 acres or 9.0 percent of the study area and is found on 24 different soil mapping unit areas. Medium-sized western hemlock dominate the overstory, and blueberry and rusty menziesia dominate the shrub layer, while the herb layer is dominated by bunchberry and five leaf bramble. This habitat type occurs at all elevations below the subalpine zone. This habitat is considered upland.

Alpine Lichen - Rock Outcrop

This nonforested plant association covers 2,609.1 acres or 7.6 percent of the study area and is found on two different soil mapping units. This type occupies the highest elevations above timberline. Plant cover generally does not exceed 50 percent but species diversity is high. Vegetation is dominated by low growing alpine sedges. There are also minor amounts of deer cabbage and sphagnum moss. This habitat type is considered upland.

Table G-9. Plant Associations in the Kensington Study Area

Plant Association	Acres
Alder - Salmonberry	4,372.0
Alpine Shrubland / Emergent Muskeg	4,354.8
Western Hemlock / Blueberry	3,212.4
Alpine Lichen - Rock Outcrop	2,609.1
Glaciers	2,214.2
Tufted Club Rush / Bog Kalmia	1,645.9
Mixed Conifer / Blueberry / Deer Cabbage	1,484.5
Mixed Conifer / Blueberry / Skunk Cabbage	1,432.7
Western Hemlock / Blueberry - Devil's Club - shallow soils	1,265.8
Western Hemlock / Blueberry - Devil's Club	1,177.0
Mountain Hemlock / Blueberry - Mertens Cassiope	1,002.7
Mixed Conifer / Blueberry	948.8
Western Hemlock / Blueberry / Spinulose Shield Fern	926.3
Emergent Tall Sedge Muskeg	727.7
Western Hemlock / Blueberry / Skunk Cabbage	500.2
Emergent Mixed Forb / Grassland	483.8
Western Hemlock - Alaska Cedar / Blueberry	448.9
Sitka Spruce / Blueberry	337.2
Mixed Conifer / Copperbush	195.8
Sitka Spruce / Blueberry / Devil's Club	149.6
Bluejoint / Mixed Forb	127.5
Alkali Grass - Sand-spurry	95.6
Sitka Grass / Alder	77.9
Silverweed / Hairgrass / Lyca	63.7
Sitka Spruce / Devil's Club	5.9

Table G-10. Forest Plant Associations By Soil Type

Soil Map Unit	Forest Plant Associations	Percent Composition
53M	Alder - Salmonberry	35
	Emergent Tall Sedge Muskeg	30
	Emergent Mixed Forb / Grassland	20
53Y	Sitka Spruce / Blueberry - Devil's Club	35
	Sitka Spruce / Blueberry	35
	Sitka Spruce / Alder	20
61T	Tuft Club Rush / Bog Kalmia	45
	Mixed Conifer / Blueberry / Skunk Cabbage	35
	Mixed Conifer / Blueberry / Deer Cabbage	20
62M	Tuft Club Rush / Bog Kalmia	90
62T	Tuft Club Rush / Bog Kalmia	40
	Mixed Conifer / Blueberry / Skunk Cabbage	35
	Mixed Conifer / Blueberry / Deer Cabbage	20
63P	Tuft Club Rush / Bog Kalmia	45
	Mixed Conifer / Blueberry / Deer Cabbage	25
	Mixed Conifer / Blueberry	20
63T	Tuft Club Rush / Bog Kalmia	40
	Mixed Conifer / Blueberry / Skunk Cabbage	35
	Mixed Conifer / Blueberry / Deer Cabbage	20
71	Alkali Grass - Sand-spurry	30
	Silverweed / Hairgrass / Lyca	20
	Bluejoint / Mixed Forb	40
74E	Sitka Spruce / Blueberry - Devil's Club	45
	Sitka Spruce / Blueberry	20
	Sitka Spruce / Devil's Club	20
44KD	Western Hemlock / Blueberry	35
	Western Hemlock / Blueberry - Devil's Club - Shallow Soils	20
	Mixed Conifer / Blueberry / Skunk Cabbage	20
44ND	Western Hemlock / Blueberry	35
	Western Hemlock - Alaska Cedar / Blueberry	35
	Mixed Conifer / Blueberry	10
44NE	Western Hemlock / Blueberry	35
	Western Hemlock - Alaska Cedar / Blueberry	35
	Mixed Conifer / Blueberry	10
44PC	Mixed Conifer / Blueberry / Deer Cabbage	35
	Mixed Conifer / Blueberry	20
	Mixed Conifer / Copperbush	20
51J	Western Hemlock / Blueberry - Devil's Club	35
	Western Hemlock / Blueberry / Spinulose Shield Fern	25
	Sitka Spruce / Blueberry	20
51K	Western Hemlock / Blueberry	60
	Western Hemlock / Blueberry / Skunk Cabbage	30
52J	Western Hemlock / Blueberry - Devil's Club	35
	Western Hemlock / Blueberry / Spinulose Shield Fern	25
	Sitka Spruce / Blueberry	20
52T	Tuft Club Rush / Bog Kalmia	40
	Mixed Conifer / Blueberry / Skunk Cabbage	35
	Mixed Conifer / Blueberry / Deer Cabbage	20
52Y	Sitka Spruce / Blueberry - Devil's Club	35
	Sitka Spruce / Blueberry	35
	Sitka Spruce / Alder	20
36SD	Western Hemlock / Blueberry	75
37	Alder - Salmonberry	35
	Western Hemlock / Blueberry - Devil's Club - Shallow Soils	15
42KC	Western Hemlock / Blueberry	40
	Western Hemlock / Blueberry - Devil's Club - Shallow Soils	20
	Mixed Conifer / Blueberry	15
42KD	Western Hemlock / Blueberry	35
	Western Hemlock / Blueberry - Devil's Club - Shallow Soils	20
	Western Hemlock / Blueberry / Skunk Cabbage	20
42P	Mixed Conifer / Blueberry / Deer Cabbage	30
	Mixed Conifer / Blueberry	25
	Mixed Conifer / Blueberry / Skunk Cabbage	20

Table G-10. Forest Plant Associations By Soil Type (cont.'d)

Soil Map Unit	Forest Plant Associations	Percent Composition
42T	Mixed Conifer / Blueberry / Deer Cabbage Moss Muskeg Mixed Conifer / Blueberry / Skunk Cabbage	45 30 20
44JC	Western Hemlock / Blueberry / Spinulose Shield Fern Western Hemlock / Blueberry - Devil's Club Western Hemlock / Blueberry	35 25 20
44JE	Western Hemlock / Blueberry / Spinulose Shield Fern Western Hemlock / Blueberry Western Hemlock / Blueberry - Devil's Club	35 25 20
44KC	Western Hemlock / Blueberry Western Hemlock / Blueberry - Devil's Club - Shallow Soils Mixed Conifer / Blueberry	40 20 15
32SD	Western Hemlock / Blueberry	75
32SE	Western Hemlock / Blueberry	75
35JD	Western Hemlock / Blueberry / Spinulose Shield Fern Western Hemlock / Blueberry Western Hemlock / Blueberry - Devil's Club	35 25 20
35KD	Western Hemlock / Blueberry Western Hemlock / Blueberry - Devil's Club - Shallow Soils Western Hemlock / Blueberry / Skunk Cabbage	35 20 20
35ND	Western Hemlock / Blueberry Western Hemlock - Alaska Cedar / Blueberry Mixed Conifer / Blueberry	35 35 10
35NE	Western Hemlock / Blueberry Western Hemlock - Alaska Cedar / Blueberry Mixed Conifer / Blueberry	35 35 10
35SD	Western Hemlock / Blueberry	75
36KD	Western Hemlock / Blueberry Western Hemlock / Blueberry - Devil's Club - Shallow Soils Western Hemlock / Blueberry / Skunk Cabbage	35 20 20
36ND	Western Hemlock / Blueberry Western Hemlock - Alaska Cedar / Blueberry Mixed Conifer / Blueberry	35 35 10
36PC	Mixed Conifer / Blueberry / Deer Cabbage Mixed Conifer / Blueberry Mixed Conifer / Copperbush	35 20 20
11	Alpine Lichen - Rock Outcrop Alpine Shrubland / Emergent Muskeg	85 15
12A	Alpine Shrubland / Emergent Muskeg Alpine Lichen - Rock Outcrop	90 10
12S	Mountain Hemlock / Mertens Cassiope Alpine Shrubland / Emergent Muskeg	60 20
13	Glaciers, Unvegetated	100
21	Alder - Salmonberry Western Hemlock / Blueberry - Devil's Club Western Hemlock / Blueberry - Devil's Club - Shallow Soils	80 10 10
32JC	Western Hemlock / Blueberry / Spinulose Shield Fern Western Hemlock / Blueberry - Devil's Club Western Hemlock / Blueberry	30 25 20
32JD	Western Hemlock / Blueberry / Spinulose Shield Fern Western Hemlock / Blueberry Western Hemlock / Blueberry - Devil's Club	35 25 20
32JE	Western Hemlock / Blueberry / Spinulose Shield Fern Western Hemlock / Blueberry Western Hemlock / Blueberry - Devil's Club	35 25 20
32ND	Western Hemlock / Blueberry Western Hemlock - Alaska Cedar / Blueberry Mixed Conifer / Blueberry	35 35 10

Source: Kensington Soils Technical Report (ACZ, 1991)

Table G-11. Kensington Wetlands Functions and Values

Plant Association	Ground Water		Surface Hydrologic Control		Bank or Shoreline Sensitivity	Sediment Retention		Nutrient Removal & Transformation		Salmonid Habitat	Wildlife Diversity	Riparian Support	Downslope Beneficiary Sites
	Recharge	Discharge	Opportunity	Effectiveness		Opportunity	Effectiveness	Opportunity	Effectiveness				
Tufted Club Rush	Moderate-C	Moderate-C	High-C	High-C		Low-B	High-A	High-B	High-A		Moderate-C	Moderate	Low
Mixed Conifer / Blueberry / Skunk Cabbage	Low-C	Low-C	High-C	High-C		High-A	Moderate-C	High-B	High-A		Moderate-C	Moderate	High
Mixed Conifer / Blueberry / Deer Cabbage	Moderate-C	Moderate-C	Moderate-C	Moderate-C		Low-A	Low-B	Low-A	High-A		Moderate-C	Moderate	Low
Western Hemlock / Blueberry	Low-B	High-B	Moderate-C	Moderate-C		Moderate-A	Low-A	High-B	High-A		Moderate-C	High	Low
Western Hemlock / Blueberry / Skunk Cabbage	Moderate-C	Low-C	High-C	Low-C		Moderate-A	Low-C	Low-A	High-A		Moderate-C	Moderate	Low
Mixed Conifer / Blueberry	Moderate-C	Moderate-C	High-C	Moderate-C		Low-A	Low-A	Low-A	High-A		Moderate-C	Moderate	Low
Western Hemlock / Blueberry -Devil's Club - Shallow Soils	Low-C	High-C	High-C	Low-C		Low-A	Low-A	Low-A	High-A		Moderate-C	Moderate	High
Bluejoint / Mixed Forb	Low-C	Moderate-C	High-C	High-C		Low-B	High-A	Low-A	High-A		Moderate-C	Moderate	Low
Alkali Grass / Sand-spurry	Low-C	Moderate-C	High-C	High-C		Low-B	High-A	Low-A	High-A		Moderate-C	Moderate	Low
Silverweed / Hairgrass / Lyca	Low-C	Moderate-C	High-C	High-C		Low-B	High-A	Low-A	High-A		Moderate-C	Moderate	Low
AQUATIC SITES													
Sherman Creek Below Falls	Low-C	Moderate-C	High-C	High-C	Moderate-A	High-A	High-C	Low-A	High-A	Moderate-C	High-A	Moderate	High
Lower Ophir Creek	Moderate-C	Moderate-C	High-C	Low-C	Low-A	High-A	High-C	Low-A	High-A	High-C	Moderate-C	Moderate	Low
Upper Sherman Creek	Moderate-C	Low-B	High-C	High-C	Moderate-A	Low-A	High-B	Moderate-B	High-A	High-C	High-C	High	Low
Comet Beach	Low-A	Low-C	High-C	Low-A	Moderate-A	Moderate-C	Low-C	High-B	High-A	Moderate-C	Moderate-C	High	High
Sweeny Creek	Moderate-C	Moderate-C	High-C	Moderate-C	Moderate-A	Moderate-A	Low-A	Low-A	Moderate-C	High-B	High-C	Moderate	High

A, B, AND C designations indicate levels of certainty as per Adamus Resource Assessment, Inc. (1987b).

Glaciers

This type is characterized as unvegetated ice and is included as a miscellaneous habitat type. This type covers 2,214.2 acres or 6.4 percent of the study area. The major influence of this type on vegetation relates to the moisture supply aspects.

Tufted Club Rush Bog Kalmia

This nonforested plant association covers 1,645.9 acres or 4.7 percent of the study area on muskeg sites with undulating surfaces (mounds and hollows) on eight different soil mapping units. The dominate vegetation on these sites is tufted club rush (*Scripus caespitosus*) and other sedges in the herbaceous layer. A mixture of low shrubs, including bog laurel or kalmia, crowberry, bog and dwarf blueberry (*Vaccinium uliginosum* and *V. groenlandicum*) occur in this type. Standing water is rarely present, but the water table is often near the surface. These areas are considered wetlands.

Mixed Conifer / Blueberry / Deer Cabbage

This forested plant association covers 1,484.5 acres or 4.3 percent of the study area and is found on 9 different soil mapping units. The overstory is typically dominated by Alaska (yellow) cedar with Sitka spruce and lodgepole pine as codominant. Canopy cover ranges from 25 to 30 percent. The understory consists of a mixture of muskeg and forest plants, and this type supports the greatest vegetation diversity of any association below the alpine zone. The dominant shrubs include blueberry, rusty menziesia, and crowberry. The herb layer is dominated by deer cabbage, bunchberry. and fern leaf goldthread. This type occurs at low elevations below the subalpine zone on nearly level sites. These sites are considered wetlands.

Mixed Conifer / Blueberry / Skunk Cabbage

This forested plant association covers 1,432.7 acres or 4.1 percent of the study area and is found on 6 different soil mapping units. The overstory of this type is dominated by a mixture of western and mountain hemlock. Canopy cover ranges from 40 to 50 percent. The shrub layer is dominated by blueberry and rusty menziesia and averages 80 percent cover. The herb layer is dominated by skunk cabbage and bunchberry and fern leaf goldthread also are common. This type occurs at all elevations below the subalpine zone on nearly level sites.

Wester Hemlock / Blueberry - Devil's Club Shallow Soils

This forested plant association covers 1,265.8 acres or 3.6 percent of the study area and is found on nine different soil mapping units. The overstory is dominated by large western hemlock with minor amounts of Sitka spruce. The tree canopy cover ranges from 65 to 75 percent. Devil's club and blueberry dominate the shrub layer while the herb layer is dominated

by oak fern and various other low growing forbs. This type occurs on mid to low elevation side and foot slopes on areas that are moderately influenced by alluvial or groundwater disturbances.

Western Hemlock / Blueberry - Devil's Club

This forested plant association covers 1,177 acres or 3.4 percent of the study area and is found on nine different soil mapping units. The overstory is dominated by medium sized western hemlock with some Sitka spruce. The canopy cover ranges from 55 to 65 percent. Devil's club and blueberry dominate the shrub layer while the herb layer is dominated by small low growing forbs such as bunchberry, five leaf bramble and foam flower (*Tiarella tritoliata*). This type is found primarily on steep mountain slopes at ail elevations below the subalpine zone. This type is considered upland.

Mountain Hemlock / Blueberry / Mertens Cassiope

This forested plant association covers 1,002.7 acres or 2.9 percent of the study area and is found only on soil mapping unit 12S. The overstory of this type is dominated by mountain hemlock and the canopy cover ranges from 20 to 30 percent. The shrub layer is dominated by a mixture of low to medium sized shrubs including mertens cassiope (*Cassiope mertensiana*), starry Cassiope (*Cassiope sfelleriana*), yellow mountain heather, luetka (*Luetka pectinata*), blueberry, rusty menziesia and copperbush. The herbaceous layer is dominated by deer cabbage. Bunchberry, five leaf bramble, and fern leaf goldthread also are common. This type occurs at high elevation sites that are transitional to the alpine tundra zone.

Mixed Conifer / Blueberry

This forested plant association covers 948.8 acres or 2.8 percent of the study area and is found on 12 different soil mapping units. This type has an overstory dominated by western and mountain hemlock. Canopy cover ranges from 35 to 45 percent. Blueberry and rusty menziesia are the most common shrubs while deer fern, bunchberry, five-leaf bramble and fern leaf goldthread are the most common herbs. Shrub cover averages 90 percent while herb cover averages 45 percent. This habitat type occurs on hill tops, knobs, and mid slope benches at low elevation sites below the subalpine zone.

Western Hemlock / Blueberry / Spinulose Shield Fern

This forested plant association covers 926.3 acres or 2.7 percent of the study area and is found on 8 different soil mapping units. This type is dominated by large eastern hemlock with canopy cover values ranging from 70 to 75 percent. Blueberry dominates the shrub layer, and the average shrub cover is 65 percent. Bunchberry and five-leaf bramble dominate the herbaceous layer, and the average cover of all herbs is 35 percent. These sites occur on stable mountain and foot slope intervals. This type is the most productive of the hemlock series.

Emergent Tall Sedge Musket

This nonforested plant association covers 725.7 acres or 2.1 percent of the study area and is found only on soil mapping unit 53M. These sites are dominated by tall sedges, but short sedges also are abundant. These areas are typically very wet and are considered wetlands.

Western Hemlock / Blueberry / Skunk Cabbage

This forested plant association covers 500.2 acres or 1.4 percent of the study area and is found on 5 different soil mapping units. This site is characterized by medium sized western hemlock in the overstory which ranges from 55 to 65 percent. Dominant shrubs are blueberry and rusty menziesia, and shrub cover averages 65 percent. Skunk cabbage and five leaf bramble dominate the herbaceous layer. This type occurs on slopes generally less than 30 percent at all elevations below the subalpine zone. Sites on foot slopes, benches, and lowlands are often characterized by a high water table. These sites have a characteristic appearance of mounds and depressions with trees and blueberry rooted on the mounds and skunk cabbage in the depressions. This association occurs on wetland, and mixed wetland, and upland areas.

Emergent Mixed Forb / Grassland

This nonforested plant community occurs on 483.8 acres or 1.4 percent of the study area and is found only on soil mapping unit 53M along the Berners River. No description of this habitat type could be found; however, it appears to be similar to most muskeg areas and probably is dominated largely by various forbs and sedges. All of these areas are considered wetlands.

Western Hemlock - Alaska Cedar / Blueberry

This forested plant community occurs on 448.9 acres or 1.3 percent of the study area and is found on six different soil mapping units. Both western hemlock and yellow cedar dominate the overstory which ranges in canopy cover from 60 to 70 percent. Blueberry and rusty menziesia are the dominant shrubs with an average cover value of 85 percent. Oak fern, deer fern, bunchberry, five-leaf bramble, and five leaf goldthread dominate the herbaceous layer. These sites are commonly found on slopes where drainage or rooting are impeded at elevations below the subalpine zone. This association occurs on wetland, mixed wetland, and upland areas.

Sitka Spruce / Blueberry

This forested plant community occurs on 337.2 acres or 1.0 percent of the study area and is found on five different soils mapping units. This type is characterized by large Sitka spruce as the dominant overstory species. Canopy cover ranges from 75 to 90 percent. The shrub layer is dominated by blueberry and averages 40 percent cover. Foam flower, twisted stalk and oak fern dominate the herbaceous layer which averages 35 percent cover. This type usually occurs on uplifted benches, on intervals on alluvial fans, and frequently dissected foot slopes. These sites are considered upland.

H. WETLAND INDICATOR STATUS

This appendix was taken from the following document: IME, Incorporated. 1991. *Jurisdictional Wetland Determination for the Kensington Venture Gold Mine Project, Alaska.* Prepared for U.S. Forest Service, Tongass National Forest.

H. WETLAND INDICATOR STATUS

Scientific Name	Common Name	Status
Grasses and Forbs		
Achillea millefolium	Common Yarrow	FACU
Aconitum delphinifolium	Monkshood	FAC
Actaea rubra	Baneberry	UPL
Adiantum pedatum	Maiden-Hair Fern	FAC
Agrostis spp.	Bentgrass	FACW
Arnica cordifolia	Heart-Leaf Arnica	UPL
Arnica diversifolia	Sticky-Leaf Arnica	FACW
Aruncus sylvester	Goatsbeard	UPL
Athyrium filix-femina	Subarctic Lady Fern	FAC
Blechnum spicant	Deer Fern	FAC
Calamagrostis canadensis	Bluejoint Reedgrass	FAC
Calamagrostis leptosepala	Slender Marsh Marigold	OBL
Calamagrostis nutkaensis	Pacific Small Reedgrass	FAC
Carex anthoxanthea	Grassy-Slope Arctic Sedge	FACW
Carex bigelowii	Bigelow's Sedge	FAC
Carex lenticularis	Shore Sedge	OBL
Carex macrochaeta	Long-Awn Sedge	FACW
Carex mertensii	Merten's Sedge	FACW
Carex nigricans	Black Alpine Sedge	FACW
Carex pauciflora	Few-Flower Sedge	OBL
Carex pluriflora	Several-Flowered Sedge	OBL
Carex sitchensis	Sitka Sedge	OBL
Castilleja parviflora	Small Indian Paintbrush	FACW
Castilleja unalaschcensis	Alaska Indian Paintbrush	FAC
Cerastium spp.	Chickweed	FACW
Circaea alpinum	Enchanter's Nightshade	FACW
Claytonia sibirica	Siberian Springbeauty	FACW
Claytonia uniflora	Bluebead	UPL
Cornus canadensis	Canada Bunchberry	FACU
Corallhorrhiza mertensiana	Merten's Coralroot	UPL
Cornus suecica	Swedish Dwarf Dogwood	FAC
Coptis trifolia	Alaska Goldthread	FAC
Coptis aspleniifolla	Spleenwortleaf Goldthread	FAC
Cystopteris fragilis	Brittle Fern	FACU
Cystopteris montana	Mountain Bladder Fern	FAC
Delphinium glaucum	Tower Larkspur	FACW
Deschampsia cespitosa	Tufted Hairgrass	FAC

FAC = Facultative | FACW = Facultative Wetland | OBL = Obligate
FACU = Facultative Upland | NI = Non-Indicator | UPL = Upland

Scientific Name	Common Name	Status
Grasses and Forbs (cont.)		
Dodecatheon spp.	Shooting-Star	FACW
Drosera rotundifolia	Round-Leaf Sundew	OBL
Dryopteris austriaca	Shield Fern	FACU
Dryopteris fragrans	Fragrant Shield-Fern	UPL
Elymus mollis	Dunegrass	UPL
Epilobium spp.	Willow-Herb	FACW
Epilobium alpinum	Willow-Herb	NI
Epilobium angustifolium	Fireweed	FACU
Epilobium glandulosum	Willow-Herb	NI
Epilobium latifolium	River Beauty	FAC
Equisetum arvense	Field Horsetail	FACU
Equisetum hyernale	Rough Horsetail	FACW
Equisetum pratense	Meadow Horsetail	FACW
Erigeron acris	Bitter Fleabane	FAC
Erigeron peregrinus	Wandering Fleabane	FACW
Eriophorum angustifolium	Narrow-Leaf Cottongrass	OBL
Eriophorum spp.	Cottongrass	OBL
Fauria crista-galli	Deer Cabbage	FACW
Festuca rubra	Red Fescue	FAC
Fritillaria camschatcensis	Chocolate Lily	FAC
Galium aparine	Catchweed Bedstraw	FACU
Galium kamschaticum	Northern Wild-Licorice	UPL
Galium trifidum	Small Bedstraw	FACW
Galium triflorum	Sweetscent Bedstraw	FACU
Gentiana douglasiana	Swamp Gentian	FACW
Gentiana platypetala	None	UPL
Geum calthifolium	Caltha-Leaf Avens	FACW
Geranium erianthum	Meadow Crane's Bill	FAC
Gymnocarpium dryopteris	Oak Fern	FACU
Heracleum lanatum	Cow Parsnip	FACU
Heuchera glabra	Alpine Heuchera	UPL
Hieracium gracile	Slender Hawkweed	UPL
Hippuris montana	Mountain Mare's-Tail	OBL
Hypopitys monotropa	Pinesap	UPL
Iris setosa	Beech-Head Iris	FAC
Juncus spp.	Rush	OBL
Kruhsea streptopoides	Kruhsea	UPL
Lathyrus japonicus	Beach Peavine	FAC
Leptarrhena pyrolifolia	Leather-Leaf Saxifrage	FACW
Linnaea borealis	Twin-Flower	UPL
Listera caurina	Western Twayblade	FACU

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Scientific Name	Common Name	Status
Grasses and Forbs (cont.)		
Listera cordata	Heart-Leaf Twayblade	FACU
Lupinus nootkatensis	Nootka Lupine	FAC
Luzula campestris	Hairy Woodrush	FAC
Luzula parviflora	Small-Flower Woodrush	FAC
Lycopodium spp.	Clubmoss	FACU
Lycopodium annotinum	Stiff Clubmoss	FAC
Lycopodium clavatum	Running Clubmoss	UPL
Lycopodium selago	Fir Clubmoss	UPL
Lysichiton americanum	Yellow Skunk Cabbage	OBL
Maianthemum dilatatum	Deer Cabbage	NI
Malaxis spp.	Adder's Mouth	OBL
Mitella spp.	Bishop's Cap	FAC
Montia spp.	Miner's-Lettuce	OBL
Osmorhiza chilensis	Chile Sweet-Cicely	UPL
Osmorhiza purpurea	Purple Sweet-Cicely	FACU
Parnassia fimbriata	Fringed Parnassus' Grass	FACW
Petasites frigidus	Arctic Sweet Coltsfoot	FACW
Phleum alpinum	Alpine Timothy	FACU
Pinguicula vulgaris	Common Butterwort	OBL
Platanthera chorisiana	Choriso Bog Orchid	OBL
Platanthera hyperborea	Northern Bog Orchid	FACW
Poa spp.	Bluegrass	FAC
Poa palustris	Fowl Bluegrass	FAC
Poa stenantha	Northern Bluegrass	FAC
Polypodium glycyrrhiza	Licorice Fern	UPL
Polystichum spp.	Holly-Fern	UPL
Polystichum braunii	Prickly-Shield Fern	UPL
Polystichum lonchitis	Holly-Fern	UPL
Polystichum setigerum	None	UPL
Potentilla anserina	Silverweed	FACW
Prenanthes alata	Rattlesnake	UPL
Pteridium aquillnum	Bracken Fern	FACU
Pyrola secunda	One-Sided Wintergreen	FACW
Ranunculus spp.	Buttercup	FACW
Ranunculus occidentalis	Western Buttercup	UPL
Ranunculus uncinatus	Hooked Buttercup	FACW
Rubus chamaemorus	Cloudberry	FACW
Rubus pedatus	Strawberry-Leaf Raspberry	FAC
Sanguisorba canadensis	Canada Burnet	FACW
Saxifraga ferruginea	Rusty-Hair Saxifrage	FAC

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Scientific Name	Common Name	Status
Grasses and Forbs (cont.)		
Scirpus cespitosus	Tufted Bulrush	OBL
Selaginella selaginoides	Club Spikemoss	FACU
Senecio triangularis	Arrow Leaf Groundsel	FACW
Stellaria crispa	Crisp Starwort	FAC
Stellaria spp.	Starwort	FAC
Streptopus amplexifolius	Clasp-Leaf Twisted Stalk	FAC
Streptopus spp.	Twisted Stalk	FACU
Streptopus roseus	Rosy Twisted Stalk	FACU
Synthyris borealis	Kittentails	UPL
Taraxacum officinale	Common Dandelion	FACU
Thelypteris limbosperma	Mountain Wood Fern	UPL
Thelypteris phegopteris	Northern Beech Fern	UPL
Tiarella trifoliata	Trifoliate Foamflower	FAC
Tiarella unifoliata	Unifoliate Foamflower	UPL
Tofieldia glutinosa	Sticky Tofieldia	FACW
Trientalis europea	Arctic Starflower	FAC
Triglochin maritimum	Seaside Arrowgrass	OBL
Trisetum spp.	Oatgrass	NI
Valeriana sitchensis	Sitka Valerian	FAC
Veratrum viride	American False-Hellebore	FACU
Viola glabella	Smooth Yellow Violet	FACW
Shrubs		
Alnus crispa	Green Alder	FAC
Alnus sinuata	Sitka Alder	FAC
Andromeda polifolia	Bog Rosemary	OBL
Cassiope mertensiana	Merten's Cassiope	UPL
Cassiope stelleriana	Starry Cassiope	UPL
Empetrum nigrum	Black Crowberry	FAC
Kalmia polifolia	Pale Laurel	FACW
Ledum decumbens	Narrowleaf Labrador Tea	FACW
Ledum groenlandicum	Greenland Labrador Tea	FACW
Luetkea pectinata	Lutkea	UPL
Malus fusca	Pacific Crabapple	FACU
Menziesia ferruginea	Rusty Menziesia	UPL
Oplopanax horridus	Devil's Club	FACU
Phyllodoce glanduliflora	Yellow Mountain Heather	UPL
Ribes bracteosum	Stink Currant	NI
Ribes spp.	Currant	FAC
Rubus idaeus	Common Red Raspberry	FAC
Rubus spectabilis	Salmon Berry	FACU

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Scientific Name	Common Name	Status
Shrubs (cont'd)		
Rubus stellatus	Nagoon Berry	FAC
Salix sitchensis	Sitka Willow	FAC
Salix spp.	Willow	FAC
Sambucus racemosa	European Red Elder	FACU
Sorbus scopulina	Greene's Mountain Ash	NI
Vaccinium alaskaense	Alaska Blueberry	FAC
Vaccinium cespitosum	Dwarf Blueberry	FACW
Vaccinium groenlandicum	Bog Blueberry	UPL
Vaccinium ovalifolium	Early Blueberry	FAC
Vaccinium oxycoccos	Small Cranberry	OBL
Vaccinium parviflorum	Red Huckleberry	UPL
Vaccinium uglinosum	Bog Blueberry	FAC
Vaccinium vitis-idaea	Mountain Cranberry	FAC
Viburnum edule	Squashberry	FACU
Trees		
Alnus rubra	Red Alder	FAC
Betula occidentalis	Spring Birch	FAC
Betula papyrifera	Paper Birch	FACU
Chamaecyparis nootkatensis	Alaska Cedar	FAC
Picea sitchensis	Sitka Spruce	FACU
Pinus contorta	Lodge-Pole Pine	FAC
Populus balsamifera	Balsam Poplar	FACU
Sorbus sitchensis	Sitka Mountain Ash	UPL
Tsuga heterophylla	Western Hemlock	FAC
Tsuga mertensiana	Mountain Hemlock	FAC

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